Geological Reconnaissance Flight Over Nepal

D N WADIA

AN aerial flight for geological reconnaissance purpose over the Nepal Himalaya one of the least known regions of the Himalayan zone was undertaken on the 18th October 1949 by Dr Arnold Heim the eminent Swiss Geologist Dr D N Wadia the Geological Adviser to the Government of India and Dr M R Sahni of the Geological Survey of India By courtesy of the Government of India and the Nepal Government permission for the flight was accorded to the party and the R I A F kindly supplied a plane provided with oxygen and other equipment needed for high altitude flying up to a ceiling of 20 000 feet

The plane took off from Lucknow at 5 a m and flying for 185 miles over the plains entered the Sub Himalayan foot hills south of Butwal on the Nepal border and made for the Kali Gandak valley a tributary of the Trisul Ganga which traverses the central axis of Himalaya right across the line of snow peaks to the Tibetan border It flew along the valley making a steady ascent over the middle and inner Himalaya Its route was thus flanked by bounding eminences on either side of the valley affording comprehensive birds eye view of the structural plan of the mountains and even at times of the nature of their component rocks

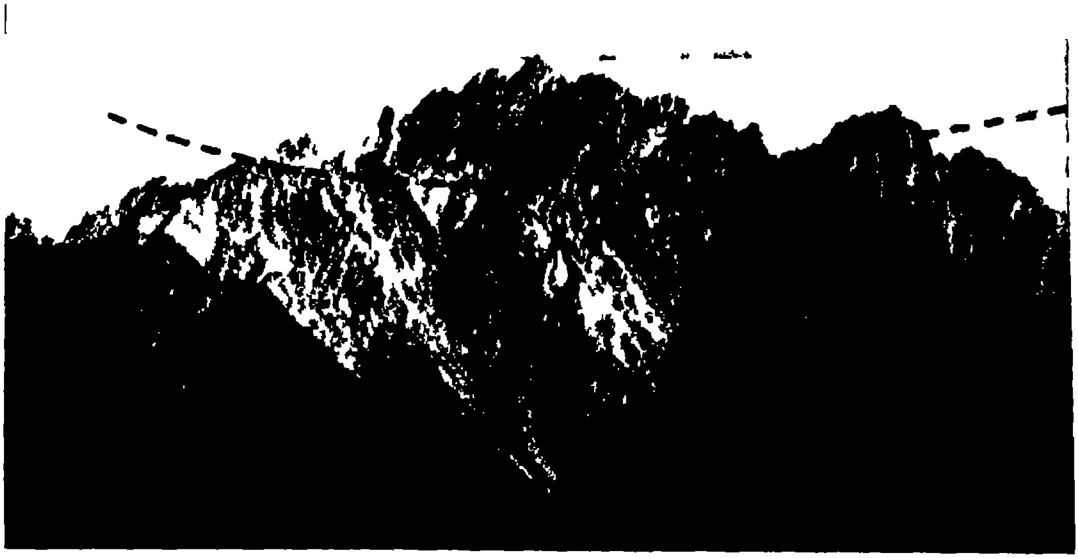

FIG 1 SHALES AND (?) LIMESTONES DIPPING NORTH IN THE TIBETAN ZONE OF THE HIMALAYA A THRUST PLANE APPEARING AS AN ALMOST HORIZONTAL LINE SHARPLY CUTTING ACROSS THE DIP PLANES CAN BE SEEN ABOUT ONE FOURTH OF THE DISTANCE BELOW THE CREST (*Photo M R Sahni View facing west*)

FIG. 2 — TIBETAN PLATEAU TYPE OF LANDSCAPE IN THE FOREGROUND NORTH OF THE HIMALAYAN AXIS. THE PLATEAU REGION IS PROBABLY COMPOSED OF SPITI SHALES (JURASSIC). (*Photo M. R. Sahni. View facing about south-east.*)

The principal geological observations taken in by the eye of the observer as well as those captured by the camera during the 4 hours' flight are summarized below.

The foot-hill zone of upper Tertiary sediments (Siwalik series) presented the usual features of a succession of low parallel ridges with south-facing escarpments and N-ly dip slopes with broad longitudinal strike valleys of the *Dun* type. To the north of this is the Mahabharat range and a broad zone of ancient Himalayan rocks — mostly pre-Palaeozoic metamorphosed sediments, slates, phyllites and quartzites belonging to the Daling series — faulted or overthrust against the Siwaliks. This is the 50-mile wide Mid-Himalayan belt with prevailing isoclinal N. dip, composed of a bewildering plexus of ranges of irregular alignation traversed by deep branching valleys and canons for the most part well cultivated and forested, succeeded by the higher ranges of snow-clad inner Himalayas composed largely of crystalline rocks, intrusive granite and gneiss into the Daling series. These constitute the central axis of the Himalayas, the zone of majestic peaks rising above 20,000 ft. covered in perennial snow. As the plane made a steady ascent over the Kali Gandak valley, the high peak of Dhaulagiri (26,795 ft.), the fifth highest peak of the Himalayas, came into view on the west of the line of flight with its geological structure of trough-folded strata clearly exposed on its south and east flank, closely followed by the Muktinath group of peaks on the east of the route (26,000 ft. to 21,000 ft.). The well-defined stratification planes of the Dalings of the middle Himalayan ranges, picked out in the clear oblique light of the morning sun, enabled one to see the large granite intrusions and the dark sombre grey, brown and rusty coloured basic and ultra-basic intrusives as the inner ranges were approached. The complex folding, inversions and dislocations witnessed in this part of the Himalaya as well as the broad characters and disposition of the rock systems appear to be of the same order, generally speaking, as in the better explored Western Himalayas.

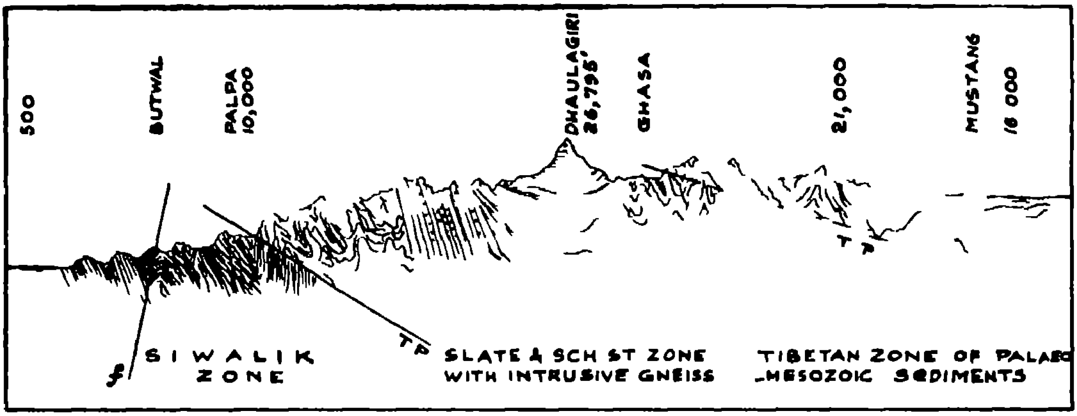
500
BUTWAL
PALPA 10,000
DHAULAGIRI 26,795'
GHASA
21,000
MUSTANG
18 000
f
T P
SIWALIK ZONE
SLATE & SCHIST ZONE WITH INTRUSIVE GNEISS
TIBETAN ZONE OF PALAE -MESOZOIC SEDIMENTS

FIG 3 — GENERALIZED SECTION ACROSS THE NEPAL HIMALAYA SHOWING BROADLY THE STRUCTURAL RELATIONS (120 MILES)

of Kashmir Garhwal and Simla * To the north of the central axis however the difference in the plan of architecture of Kashmir and Nepal Himalayas is striking Juxtaposed against the metamorphics of the Dhaulagiri Muktinath line of peaks beyond Tukusha is a faulted or mechanical junction which leads abruptly to the belt of comparatively gently folded fossiliferous sedimentary beds of Palaeozoic Mesozoic ages distinguished in Indian Geology as the *Tibetan Zone* At Muktinath temple situated on the valley floor (14 000 ft) and at Kagbeni barely 16 miles north of Dhaulagiri a report of a ground traverse by Mr G S Lamba in the year 1942 describes occurrence of extensive outcrops of limestone crowded with *Ammonite* fossils (*saligram*) The physical aspect of the mountains immediately the Great Himalayan Range is crossed undergoes a profound change the naked snowless barren rocks without any cover of vegetation either forest or cultivated look quite unlike the mountains on the Indian side of the Himalayan axis which are green with abundance of forests and cultivation and crowned in the higher slopes by snow Further north as the border of Tibet is approached well defined rock groups recognizable as Permian Trias come into view and the topography becomes more and more subdued with flat broad plateaus of wide expanse interspersed in the mountains Near Mustang the country has the Tibetan aspect of far flung smooth barren landscapes treeless and without any visible signs of human habitation The substratum of the plateau here is probably black coloured Jurassic Spiti shales laden under a mantle of loose sub recent detritus

The plane circled above Mustang and turned southwards flying barely 200 ft above the featureless water shed of the Kali Gandak on the Indo Tibetan frontier which here makes its deepest indentation northwards approaching within 25 miles the valley of the Brahmaputra This low flying enabled good photographs being taken illustrating the geology and unique topography of the country on the Indian side of the border

The overthrust of the Tibetan zone of fossiliferous sedimentary rocks on to the central axis of the Great Himalayan Range was the best observed feature of this aerial traverse The photographs thanks to the clear atmosphere and good visibility after sunrise have picked up other tectonic features including thrust planes which are being studied

The occurrence of exotic blocks an extremely interesting feature of mountain tectonics witnessed in Kumaon 250 miles north west of the Kali Gandak valley was not observed during the flight at any rate not so strikingly as that observed by Arnold Heim and A Gansser in 1935 during their geological traverse to Manasarover from Almora These exotic blocks are masses of foreign rocks of all ages (from Permian to Cretaceous) and sizes ranging from mere boulders to whole hill masses that have been thrust southwards for many miles from their original site in upper central Tibet by powerful mountain building forces They are now found overriding the indigenous rocks of Kumaon detached from their parent rock folds The extreme stratigraphic disorder in which these blocks occur today and the discordance of their structure and bedding planes to the bed rock in which they lie readily enable geologists to detect them by the eye or by aerial photographs taken at an oblique angle

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* D N Wadia — Structure of the Himalayas & of the North Indian Foreland Presidential Address Geology Section Indian Science Congress 1938

Characteristics of the Ionosphere over Calcutta (October 1949)

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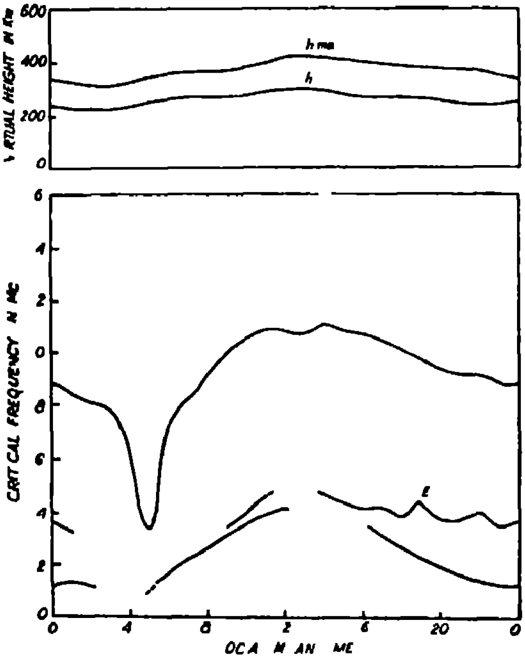
THE following are the ionospheric data observed at Calcutta for the month of October 1949

Fig 1 represents the mean hourly values of the penetration frequencies of the E and F regions and the penetration frequencies and virtual heights of region F_2 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum



(5 HR 54 MIN AHEAD OF G M T)
FIG 1 OCTOBER 1949

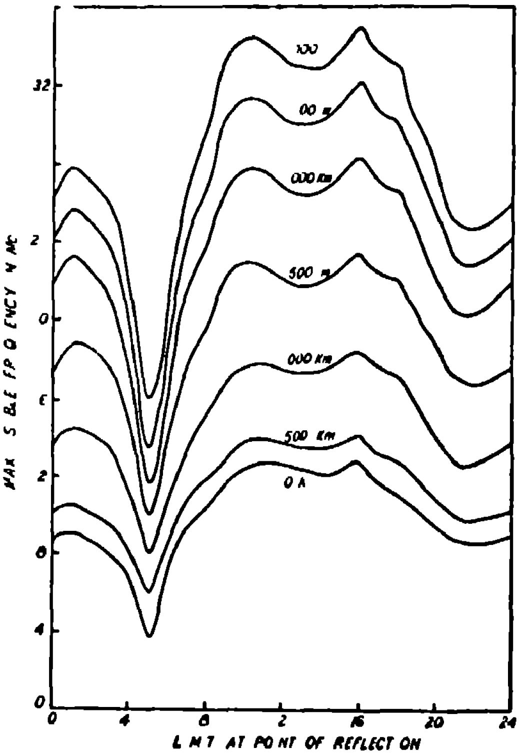


FIG 2 — PREDICTED M U F VIA F_2 LAYER
JANUARY 1950

usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of January 1950 Table I gives the different occasions during routine observation when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights

Sporadic E ionization was found to occur less frequently in this month Absorption of normal E echoes at mid-day was also less The behaviour of region F_2 was found to be normal

TABLE I

MONTH & YEAR	DATE	HOUR	$f^{\circ}_{E_s}$ Mc	h_{E_s} Km
October 1949	4	16 00	4 35	185
		17 00	3 80	135
	8	16.00	4 70	135
	11	17 00	4 00	135
		22.00	4 80	135
		23 00	4 60	120
	12	00 00	4 00	105
	14	17 00	4 75	135
		18.00	5 00	135
		19 00	4 40	120
		20 00	4 40	120
October 1949	15	11 00	4 60	150
		18 00	3 45	135
	18	17 00	3 35	120
		18.00	3 20	120
	19	10 00	4 00	185
	20	09 00	3 45	185
		10 00	3 60	135
		17 00	3 30	135
		18.00	3 20	135
		22 00	4 60	135
		23 00	4 40	135
	21	00 00	3 20	120
		01 00	3 20	105
		20.00	3 00	120
		21 00	4 25	120
	22	14 00	4 60	135
	24	17 00	3 80	120
		21 00	3 00	105
		22.00	1 95	90
		23 00	1 30	90
	25	10 00	4 50	135
		17 00	4 50	135
		22.00	4 50	120
	28	16 00	2 50	120
		17 00	5 00	135
	31	19 00	3 40	120
		20.00	3 45	120

A Review on the Ceramic Dielectric & Insulator Materials for Low Loss & High Frequency Uses

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THE rapidly growing use of short-waves and ultra-short-waves for high frequency applications confronts the manufacturer of electrical insulating materials with new problems In high frequency circuits such as radio, radar, television, communications generally, ignition circuits, electro-medical X-rays and the like, the most important single feature determining the utility of a particular insulator structure is the power loss factor characteristics of the finished piece The material used must meet certain definite electrical specifications in order to be useful

Ceramic insulators are favoured because of their excellent combination of good dielectric properties, high mechanical strength, extremely permanent rigidity and refractoriness Other dielectrics, like bakelite, resins, etc , fail at high temperatures Normal porcelain does not have the proper dielectric properties that are necessary for high frequency work Some dielectric materials like quartz cannot be easily fabricated, but are otherwise excellent

The frequencies encountered vary from the common light circuit at 60 cycles/sec to ultra-high frequencies which may be as high as 3,000 megacycles/sec

The type of pieces made from such low loss ceramic materials include rod antenna insulators, tube socket bases, supports and spacers in vacuum and electron tubes, capacitors, switch parts, coil forms, stand-off insulators, bowl insulators, insulating washers, rheostat assemblies, automotive spark plugs, high pressure ignition plugs, etc

The Loss Factor

The utility of an insulator depends upon the value of its power loss factor Before going into the actual study of the ceramic materials for high frequency uses, it is desirable to have a knowledge of the loss factor and the factors causing these dielectric losses

Any insulating material between two electrodes constitutes a capacitor If such a condenser of capacity C is subjected to the potential E, a radio frequency field having the frequency f, a current I will flow through the condenser If we introduce the angular velocity $\omega = 2\pi f$, then $I = E\omega C$ and energy to charge the condenser is $EI = E^2\omega C$ The energy actually used in the condenser and transformed into heat is given by the equation $N = E^2\omega C$ tan δ, where ω = loss angle and tan δ = dielectric power factor

This formula shows that for a given potential and capacity, the power factor has to be extremely small in order to keep the product $E^2\omega C$ tan δ small, especially at high frequencies

Effect — In a high frequency field, the energy consumed by dielectric loss is transformed into heat If, for instance, energy is taken from the primary oscillating circuit of a receiver where amplification has not yet taken place, the quality of reception and selectivity are impaired seriously In transmitters where high potentials are used, the development of heat through dielectric losses of the insulating material present a serious problem A rise in temperature results in further increase of dielectric loss, and the mutual increase of temperature and power factor leads up to a point where input of heat is in equilibrium with heat radiated out Before this point is reached, however, complete electrical break-down of the electrical insulator may have taken place

The best insulating material for high frequency work is vacuum and air with dielectric constant of 1 and a power factor of 0 But the need is for rigid and solid insulators for supporting and separating metallic conductors

Other factors that cause dielectric losses in ceramic insulator are

(1) *Ohmic Resistance* — Direct conductivity through the dielectric material shows up in the form of dielectric losses This is true both for volume and surface conductivity For any well-vitrified insulating parts, these losses are negligible at ordinary temperatures and dry atmosphere At elevated temperatures volume conductivity may cause complete break-down of the insulator and under humid conditions the surface conductivity may become appreciable Because an unglazed ceramic material has a microscopically rough surface which permits moisture to settle in a continuous path, a glazed surface is desired or coating with moisture-resistant wax or varnish gives good results The latest development in this line is of silicone varnishes, which possess a high degree of water repellancy and thereby allow the equipment to work under conditions of humidity and high temperature

(2) *Polarization* — Dielectric losses may be caused by the dipole moment of polarized molecules in the electrical field But these losses are not important in ceramics

(3) *Non-homogeneity* — Non-homogeneity of the structure of the insulating material may cause dielectric losses For ceramics the non-homogeneity may be defined as the presence of the crystalline and glassy phases in one material A dielectric of this type has higher dielectric loss than the components of the mixture, especially if the quotient of conductivity and the dielectric constant is different for the single components of the mixture

(4) *Oxides* — Those oxides which show excessive electrical conductivity at elevated temperatures cause dielectric losses in ceramic materials

Requirements of a Ceramic Dielectric Material

The general properties required of ceramic dielectric and insulator materials to be classed as fit materials are as follows

(1) *Porosity* — High or zero, as the service requires

(2) High dielectric strength and high specific resistance

(3) Low power loss factor, especially for service at high frequencies

(4) High dielectric constant, especially for condensers

(5) Nos 2 to 4 effected by temperature changes as little as possible

(6) High mechanical strength

(7) Smooth surface to prevent condensation of moisture and gathering of dirt

(8) Absolute homogeneity with respect to glass to crystal ratio and also with respect to types of crystals present A one-component system is ideal

(9) Accuracy of dimensions (tolerance of ±1 0 per cent in dimensions over 0 5″ are usually met without special fabrication) This entails very low shrinkage

(10) Low thermal expansion is necessary to prevent "drift" in aircraft radios because of extreme temperature changes when they are carried from low to high altitudes, and also to prevent the drift while the radio is heating up and

(11) forming and shaping

Ceramic Materials Used for High Frequency

Ceramic insulators can be divided under three main heads (1) porous, (2) vitreous non-glazed and (3) glazed

(1) *Porous* — Insulators of this type can be used only under low voltage and low frequencies and under dry conditions where moisture will not condense on the surface causing flash-over or surface leakage High porosity[1] is requisite where evacuation must be complete and quickly accomplished, as for supports in vacuum tubes These are generally made of refractory oxides, Al_2O_3, BeO, MgO, ZrO_2, ThO_2 and low-fired cordierite Porous insulators have the added advantage of being able to withstand thermal shocks well

(2) *Vitreous Non-glazed* — This type is used where high mechanical strength is necessary and where cleanliness is not an important factor Such electrical insulators are satisfactory for service at high voltage and frequencies They must have a smooth surface to prevent moisture condensation and many of them are waxed for this reason

(3) *Glazed* — The porous and some of the vitreous ceramic insulators have a rough surface and must be glazed to obtain a smooth surface which will prevent moisture condensation and the collection of dirt

Ceramic Dielectrics & Insulators

The main ceramic bodies used for this purpose are steatite, cordierite, rutile and zircon The less important ones will be dealt with later on

Steatite Bodies — Under this group fall the ceramic products which have talc[2] or soap-stone ($3MgO\ 4SiO_2\ H_2O$) as the chief component and contain at least 80 per cent of Mg silicate in the unfired mixture These bodies are essentially mixtures of talc, clay (added to provide both green and dry strength) and feldspar as flux Potash feldspar and not soda feldspar is used since K_2O is far less detrimental to the power loss than Na_2O[3] The amount of flux used generally varies between 10-20 per cent The dielectric losses of steatite bodies are found to be considerably lower than the porcelain bodies with 25-30 per cent flux in them This is explained as steatite bodies contain 90 per cent crystalline and 10 per cent glassy phase and the porcelain 60 per cent crystalline and 40 per cent glassy phase So, to further reduce the dielectric losses in steatite bodies, the reduction of glassy phase is attained by replacement of flux which may develop during cooling or form crystalline products by reacting with talc[4] Fluxes of this type are found to be Al_2O_3, alkaline earth oxides and even mixtures of various oxides (Al_2O_3 in crystalline phase is beneficial but in glassy phase is harmful) Cristobalite from decomposition of talc and clay is undesirable as it gives high thermal expansion It is largely eliminated by additions of alkaline earths to the body compositions

The coefficient of capacitance change and power factor loss can be altered by additions of 5-10 per cent $MgTiO_3$, $BaTiO_3$, ZrO_2[5], TiO_2, BeO, fused MgO, etc These are substances which will remain crystalline during the firing process and, therefore, effect the dielectric constant, power factor, etc The best low loss bodies contain BeO with a BeO BaO ratio of 1 22

In the fired state, insulators of this class are predominantly clinoenstatite with a small amount of mullite and glass

The main defect in these bodies is that the firing range is only ½ to 1 cone which causes difficulty in its manufacture

Cordierite Bodies — High thermal expansion is an undesirable property where absolute counting of oscillating circuits has to be maintained If, for instance coil forms are made of a material with high coefficient of expansion, oscillations may shift by mere temperature changes due to the physical change of the size of the coil form For such cases, the materials of low coefficient of expansion are required Cordierite answers requirement in these bodies Again one of the main ingredients is talc The body composition ($2 MgO 2Al_2O_3 5SiO_2$) with theoretical proportions consists of 39 6 per cent talc, 47 per cent clay and 13 4 per cent Al_2O_3 But bodies of this composition have such a short vitrification range that it is practically impossible to manufacture them Therefore, the amounts of Al_2O_3 and talc are reduced to get a body containing maximum amount of cordierite crystals and having adequate firing range Sometimes ZrO_2 is also added which is said to lengthen the firing range

These bodies cannot be glazed satisfactorily due to their very low coefficient of expansion The unglazed products have rather rough surfaces due to the minute crystals, therefore, surface conductivity is likely to occur under humid conditions

Sometimes self-glazing is also practised by the addition of certain fluxes like feldspar, nepheline syenite and feldspar-zinc oxide Spodumene and feldspar and beryl and feldspar have also been tried but not with much success Slip glazing found suitable for the bodies have the chemical compositions SiO_2, 52 0, Al_2O_3, 13 5, MgO, 15 5, Be_2O_3, 3 2, Fe_2O_3, 9 0 and Cr_2O_3, 6 5 It gives smooth semi-mat glaze

This glaze layer fits the body as its thickness is only between 0 001″-0 002″ and is intimately connected with the body by cordierite crystals extending from the body into the glaze

Power factor values of cordierite lie between those of electrical porcelain and the steatite and vary slightly with composition It has been found that the feldspar content of the glazed articles has some effect on the power factor

Rutile Bodies — For high frequency application, condensers with low dielectric losses and concentrated capacities are desirable, in other words, condensers of high capacity but of small size Mica is used for this purpose but it has the defect of having variations from piece to piece and warping with age and moisture Steatite has been suggested but they are comparatively bulky and cannot be easily used in radio constructions where space is limited

Rutile has been found to possess a dielectric constant value of 183[6] parallel to its crystal axis and 89 perpendicular to the axis A crystal mixture gives an average value of 110 dielectric constant[7] By adding certain fluxes like titanite (CaO TiO_2 SiO_2), alkali-free titania glasses or MgO titanate, BeO titanate, ZrO_2 titanate, etc, it is possible to produce vitrified ceramic bodies which consist chiefly of rutile crystals with dielectric constant not much less than 110

The power factor of such bodies is low and within the limits of low loss ceramic materials at high frequencies At low and audio frequencies, however, the power factor increases considerably

It shows a negative temperature coefficient of dielectric constant, that is in bodies with high dielectric constant, increase in temperature decreases the dielectric constant As this negative property is the physical property of rutile, temperature-independent dielectrics can be made only by reducing the TiO_2 content considerably and, therefore, at the same time lowering the dielectric constant Bodies with dielectric constant between 10-20 are practically independent of temperature

Zircon Bodies[10] — Considerable research has been done to develop ceramic insulator bodies having the dielectric properties of low loss steatite bodies, but having a longer firing range Work along this line has been done by *Titanium Alloy Manufacturing Co*, Niagra Falls (N Y), U S A They found that mixtures of zircon and zirco-silicates of barium, calcium, magnesium bonded by clay would produce a body having an unusually long firing range Such bodies were reported to have a firing range of about 300°F before maturity The defect with zircon bodies is that as the material is very abrasive it eats away the dies in extrusion and dry pressing

Minor Ceramic Materials

(1) *Glass*[9]— Soda-lime glass has low specific resistance, a low dielectric constant and large coefficient of capacitance with temperature change Pyrex and special alkali-free glasses are much better, but have high dielectric losses at elevated temperatures and at high frequencies Rapid change in

dielectric properties with temperature variations prevent its use in many applications

(2) *Clear Fused Quartz* — Fused quartz has a very high volume resistivity and very high dielectric constant It has the lowest loss of any dielectric

(3) *Porcelain* (i) *Normal* — The clay-flint-spar porcelains contain from 40 to 60 per cent of glass containing alkali ions and, therefore, have a rapid change in electrical properties with temperature variations They also have large power loss at high frequencies (ii) *Mullite*[2] — This class is particularly well suited for spark plugs because of its high thermal conductivity It contains little glass but exhibits high power losses at high frequencies

(4) *Al_2O_3, MgO, BeO, etc* — The porous refractory oxides are usually bonded with a small amount (2-5 per cent) of clay or talc All have very high dielectric strengths at high temperatures For giving the green strength a paste of flour, ammonia and water is generally used

(5) *Alsifilm* — Dried montmorillonite films impregnated with polystyrenes and resins for pliability have been developed to replace mica in flat irons, toasters, etc The dielectric constant is about 4-6

(6) *Lava* — This type of electric insulator is cut from steatite rock, machined and drilled and then fired to 1,000°C There is little or no linear firing shrinkage The fired product is mostly clino-enstatite with some cristobalite The coefficient of thermal expansion is $9\ 0 \times 10^{-6}$ and the dielectric loss is 1 5 per cent, a fairly high value Its greatest use is in making " first models " before making expensive dies It is also used for vacuum tube spreaders

(7) *Mycalex* — Fine-grained mica is formed (with pyro-plastic at 750°C) at 5,000 lb per sq in by using either potassium iodide or lead borate bonds, which are soft at this temperature Both the compression and injection processes are used These insulators begin to soften at 450°C but are machinable like unfired lava at room temperature The dielectric losses are fairly low and the dielectric constant is about 8·0

(8) *Pyrophyllite* — Pyrophyllite insulators have been made with over 94 per cent pyrophyllite and 6 per cent " plastic flux " and fired to cone 14 These have been found to be superior to porcelain but inferior to steatite

Properties of Ceramic Insulators & Dielectrics

(1) *Dielectric Constant* — Rochelle salt is reported to have a dielectric constant of about 20,000 in one crystallographic direction at −18°C and at +24°C Rutile has a mean dielectric constant of 110-114 The titanates have a dielectric constant of 20-30 and ZrO_2 has a dielectric constant of 18

Mixtures of TiO_2 with other crystalline substances closely obey the equation

$$\log \epsilon = X_1 \log \epsilon_1 + X_2 \log \epsilon_2$$

where ϵ_1 and ϵ_2 represent the dielectric constants and X_1 and X_2, per cent components by volume This equation is approximated by other dielectric materials especially if all components are crystalline

Porcelains have a dielectric constant of about 6-8 and all steatite products have a slightly lower value of 5-6

As a rule Na_2O and Al_2O_3, especially when in glassy phase, lower the dielectric constant K_2O and Li_2O are less detrimental than Na_2O

(2) *Dielectric Loss & Power Factor* — A high dielectric constant and a high volume resistivity do not often indicate a low power factor and low dielectric loss For example, rutile may have a dielectric constant of 100 and a loss of 0 2 per cent while vitreosil has values of 3 5 and 0 06 respectively Vitreosil has the lowest loss factor of all the common materials, followed closely by low loss steatite and mica Steatite, normal porcelain and pyrex have slightly higher losses

Glasses containing " free ions " and dipole components have large losses The ideal dielectric material has zero power factor and consequently zero dielectric loss

(3) *Coefficient of Capacitance Change* — To have a constant amount of energy stored in a condenser with temperature variation, the capacitance of the dielectric must remain constant Porcelain has a large positive coefficient of capacitance change ($5\ 0\text{-}7\ 0 \times 10^{-4}$/°C) while rutile has a large negative coefficient ($-7\ 0\text{-}7\ 4 \times 10u^{-4}$/°C) Porcelain has a dielectric constant of about 8 at 25°C and increases to 63 at 100°C The dielectric constant of rutile decreases from 100 at approximately the same rate Steatite and cordierite are remarkably stable Combinations of positive and negative dielectrics are incorporated in aircraft radios so that the total capacitance change is zero with temperature change

Rutile can be mixed with positive dielectrics (ZrO_2 for example) to produce condensers of constant capacitance change.

(4) *Coefficient of Thermal Expansion* — Vitreosil has the lowest coefficient of thermal expansion among the insulators, being 0·5 × 10^{-6} per cent/°C. This is followed by the theoretical cordierite at 0·53 × 10^{-6} per cent/°C, and commercial cordierite at about 1·5-2·0 × 10^{-6} per cent/°C (FIG 1).

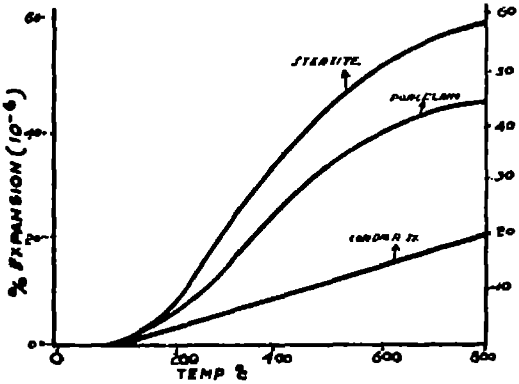

FIG 1

The thermal expansion is important from two stand points (i) constancy in induction coils and (ii) resistance to thermal shocks. Cordierite has its greatest application for coil forms where constancy of inductance is necessary and where dielectric loss is the determining requisite. Soda-lime glass, lava and rutile have the highest coefficient of expansion (about 9 × 10^{-6} per cent/°C). Steatite and normal porcelains have coefficients of expansion slightly lower than lava. As a rule, porous bodies are much more resistant to thermal shock than denser bodies even though the coefficient of expansion may be higher.

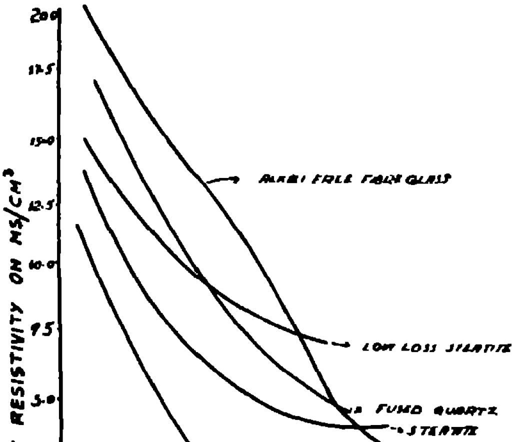

FIG 2

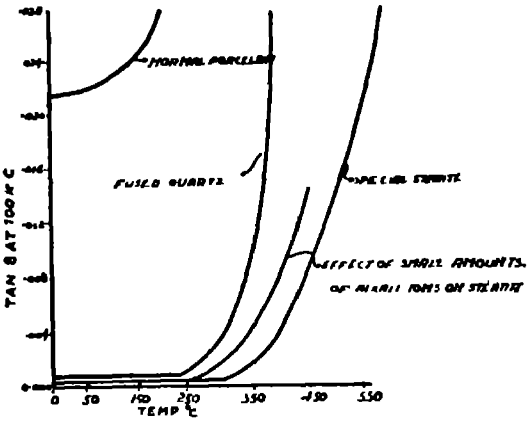

FIG 3 — EFFECT OF TEMPERATURE ON POWER LOSS

(5) *Mechanical Strength* — The steatite insulators are only next to zircon insulators in strength. The compressive strength goes up to 1,00,000 lb per sq in. Rutile and porcelain sometimes go higher, up to 1,20,000 lb per sq in. The porous cordierite insulators are noticeably weak, especially when the composition approximates to the theoretical value.

Steatite bodies have an unusually high tensile strength and this, combined with its compressive strength, produces great toughness. It is presumed that the strength of the steatite bodies is due to the nature of the clino-enstatite crystals.

(6) *Thermal Conductivity* — The combination of high thermal conductivity and mechanical strength give steatite good resistance to thermal shocks in spite of its high coefficient of thermal expansion. Glass, porcelain and others have rather low thermal conductivities.

(7) *General Effects of Temperature on Frequency* — The power factor and power loss factor, as a rule, increase with rise in temperature. The volume resistivity and dielectric strength decrease with increase in temperature in dielectrics containing glass

TABLE I — ELECTRICAL PROPERTIES OF INSULATORS AT ROOM TEMPERATURES

TYPE OF INSULATOR	VOLUME RESISTIVITY ohms/cm cube	COEFF OF EXPANSION 20° 100°C.$\times 10^{-6}$	DIELECTRIC CONSTANT AT 1 MC	DIELECTRIC LOSS FACTOR % AT 1 MC	COEFF OF CAPACITANCE CHANGE $\times 10^{-4}$
Rutile	X	7 9	30-100	0 1-0 4	—(7 0-7 4)
Lava	10^6	9 0	5 2	1 5	X
Mica	10^{17}		4 0 8 0		X
Mycalex	10^{14}	8 0	7 5 8 5	0 2 2 0	X
Steatite	10^{14}	6 4	5 0 6 5	1 2	X (1 2 1 6)
Low loss steatite	10^{14}	6 3	6 0	0 04 0 17	X (1 2-1 6)
Porcelain	10^{15}	4 0	6 0 8 0	1 7 2 5	X (5 0-6 0)
Soda lime glass	10^{12}	8-10	3	5 7	X
Pyrex	10^{18}	3 5	5	0 7	X
Vitreosil	10^{19}	0 5	3 5	0 08 0 05	X
Cordierite	10^{15}	0 53 1 8	5 2	2 0	X

and free ions of K^+ and Na^+ Soda-lime glass may have high resistance at room temperature, but becomes a conductor at 150°C Crystalline Al_2O_3 is remarkable in its high volume resistivity of about 5,000 ohms/cm cube at 1,600°C, when practically all the common dielectrics would melt Because of its high heat conductivity, refractoriness and resistivity at high temperature, vitreous Al_2O_3 is much favoured for aircraft spark plugs MgO, BeO and ThO_2 are of the same class

The power factor and dielectric constant decrease as the frequency is increased The dielectric loss at high frequencies is sufficient to cause heating of the dielectric The power factor becomes quite constant at about 2-3 megacycles and above

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The Use of Wetting Agents in Acidizing of Oil Wells

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THE acidizing of oil wells is a well-established practice[1] for improving production, particularly of those wells which have passed through the normal process of decline Hydrochloric acid of 15 per cent concentration is usually employed, and 1,000 gallons of acid dissolve 1,800 lb or 11 cu ft of limestone[2] The acid concurrently attacks metallic equipment and piping at $\frac{1}{1000}$ to $\frac{1}{100}$ the rate of attack on limestone This action is of serious consequence, especially if the acid remains in the well for some time It is, therefore, customary to add inhibitors to prevent or greatly minimize metallic corrosion while the dissolution of the limestone proceeds unaffected

It has been observed that acidizing in many instances produces little or no beneficial effect on production This has been attributed to the presence of the oil layer covering the limestone face and the capillaries which prevent the acid from coming into contact with the rock In such cases the addition of wetting agents has proved helpful

Wetting agents were used at Dhulian oilfields with marked improvement in the rate of production "Calsolene H S Oil", an *I C I* product, was used in dilute aqueous solution for the wetting operation "Fixanol" was added to the acid The latter, in addition to lowering of surface tension, acted as a corrosion inhibitor During the early years of World War II, when the supply of chemicals from U K to India became uncertain, the indigenous production of wetting agents from the raw materials available in India became a matter of urgent necessity

Preparation of Wetting Agents

The main structural feature of effective wetting agents appears to be that they consist of molecules in which polar and non-polar groups occur in a balanced proportion[3] Recent work has shown that polar bodies possessing hydrocarbon chains of not more than 12 carbon atoms in length possess wetting characteristics, while those with longer chains exhibit dispersing and emulsifying properties[4] Vegetable oils provide useful raw materials for the production of a variety of such reagents Of these, coconut oil has the most favourable composition[5] (TABLE I) The utilization of coconut oil for preparing suitable wetting agents thus suggested itself

TABLE I

ACID	NUMBER OF C ATOMS	%
Caproic	6	2
Caprylic	8	9
Capric	10	10
Lauric	12	45
Myristic	14	20
Palmitic	16	7
Stearic	18	5
Oleic	18	2

160 gm of fatty acids from coconut oil were stirred with 60 gm of chlorosulphonic acid, the temperature of the mixture being maintained below 22°C Stirring was continued for 8 hr The mixture was allowed to stand overnight and excess acid was removed by repeated washing with ice-cold sodium chloride solution A solution of sodium hydroxide was then added until *just* alkaline

Evaluation of Wetting Agents

Draves' method[6] was employed for the evaluation of wetting powers of the preparations 3-ply unboiled cotton yarn was used As the type of yarn used has a profound influence on the sinking time, a sufficient supply from one particular stock was obtained "Aerosol O T dry", an extremely active wetting agent, was included for comparison The results obtained are summarized in Table II and are graphically represented in Figs 1, 2 and 3

TABLE II

Temperature 25°C

WETTING AGENT	% CON	SOLVENT	SINKING TIME sec	pH
Aerosol O T dry	0 025	Distilled water	5	6 85
	0 025	15% HCl solution	239	
	0 010	Distilled water	17	
	0 005	„	40	
	0 100	15% HCl solution	32	
Calsolene H S	0 10	5% „	210	
	0 10	Distilled water	10	6 4
	0 02	„	55	
	0 01	„	96	
Sulphonated coconut fatty acids	0 10	„	14	7 2
	0 10	5% HCl solution	287	
	0 02	Distilled water	83	
	0 01	„	190	
Fixanol	0 10	„	43	
	0 02	„	173	
	0 01	„	270	
	0 10	5% HCl solution	11	
	0 10	15% „	8	
	0 05	„ „	18 5	
	0 025	„ „	34 5	
		Distilled water	613	

Though surface-tension characteristics cannot be taken as a definite indication of wetting power, yet it provides an indication of its suitability as a test material Surface tension was determined by the Donnan pipette method The results obtained are summarized in Table III

Corrosion Inhibitors

The inhibiting properties of various arsenic compounds and Fixanol on the corrosion of mild steel by sulphuric acid were studied and the results obtained are summarized in Table IV

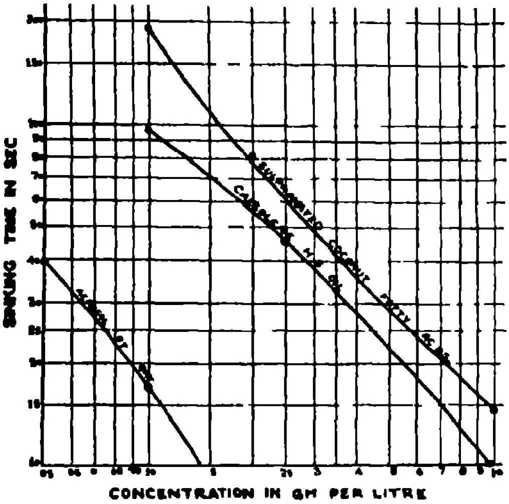

FIG 1 — SINKING TIME VERSUS CONCENTRATION FOR THE THREE WETTING AGENTS AT *p*H 7

TABLE III

Temperature 25 C

WETTING AGENT	% CON	DENSITY	SURFACE TENSION (Dynes/cm)
Aerosol O T dry		0 997	71 97
	0 02	0 998	38 8
	0 10	0 998	30 07
Calsolene H S	0 10	0 998	43 34
Sulphonated coconut fatty acids	0 10	0 999	42 07
Fixanol	0 10	1 00	36 9

Discussion of Results

Surface tension determinations (TABLE III) show that Aerosol O T dry is exceptionally effective in lowering the surface tension The results of Draves test show that the sulphonated fatty acids from coconut oil constitute as good a wetting agent as Calsoline H S and that its wetting power is considerably decreased when the *p*H is increased to 3 On the other hand the wetting power of dilute solutions of Fixanol at *p*H 7 is inferior to any other wetting agent studied in the present investigation A surprising improvement is recorded when the product is tested in 15 per cent HCl solution It has decidedly greater wetting power than Aerosol O T dry when tested in the same medium

The corrosion inhibiting properties of the various substances studied show (TABLE IV) that sodium arsenite is the best

TABLE IV

Temperature 25°C *acid* 10% H_2SO_4 (*by vol*)

INHIBITOR	% CON	TIME OF REACTION	% LOSS IN WT
		24 hr	18 9
As_2O_3	0 5		7 0
Sodium arsenite	0 5		0 23
Fixanol	0 5		12 54

In evaluating a wetting agent for use in acidizing operations it appears that a distinction should be made between the treatment of a new well which merely consists in cleaning the rock face and the operations intended to revitalize an old well by enlarging the capillaries of the limestone In the latter case the acid should penetrate the capillaries overcoming if necessary, the gas blocking or jamin effect which resists the penetration of the acid It has been contended that a wetting agent helps to bridge the gas locks and so enables deeper penetration of acid than would otherwise be possible Obviously in such cases the wetting agent is introduced along with the acid and the

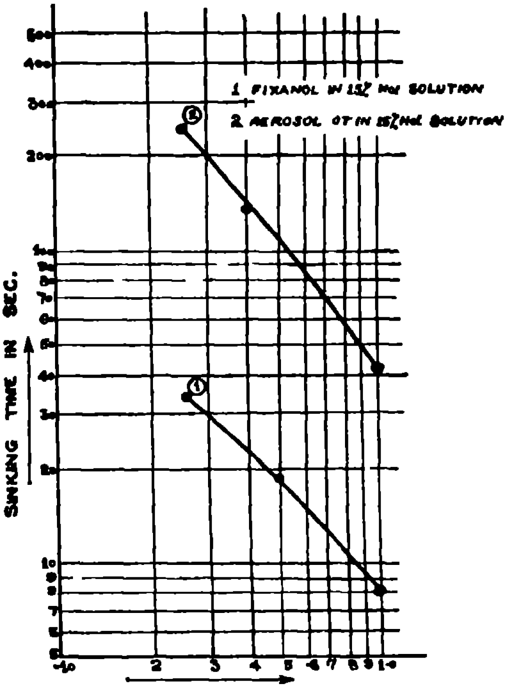

FIG 2 SINKING TIME VERSUS CONCENTRATION IN 15 PER CENT HCl SOLUTION FIXANOL AND AEROSOL O T DRY

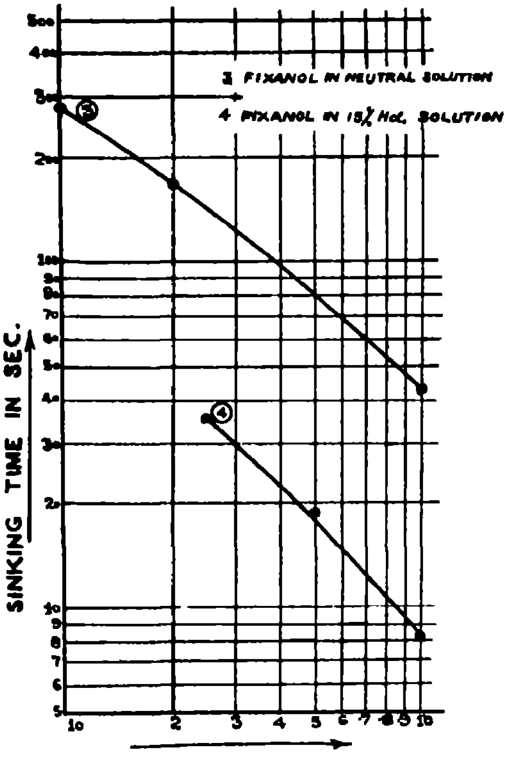

FIG 3 — SINKING TIME VERSUS CONCENTRATION FOR FIXANOL IN 15 PER CENT HCl AND NEUTRAL SOLUTIONS

activity of the wetting agent in a strongly acid medium becomes important The results of " Calsoline II S " and coconut oil sulphonation product in 5 per cent HCl show that these agents are not suitable for such work Fixanol, being active in acid medium, assists the acid reactivity and, therefore, should be particularly effective where the enlargement of limestone capillaries in oil wells is desired

Naik and Desai[7] have studied extensively the sulphation and sulphonation of Indian vegetable oils using sulphuric acid, oleum and chlorosulphonic acid as sulphonating agents They have not tried either coconut oil or its fatty acids Venkataraman and his collaborators[8] have recently synthesized a large number of compounds, particularly the sulphonic acid derivatives, from the common Indian vegetable oils for use in the textile industry With the exception of lauric acid all other acids yielded poor wetting agents Lauric acid furnished highly efficient surface-active compounds When similar compounds were prepared by condensing coconut oil without the isolation of lauric acid, they were comparable with those obtained from lauric acid only at higher concentrations but were less effective in dilute solutions The results of the present investigation clearly support the above findings

The result of this investigation were made available to *Messrs Attock Oil Co Ltd*

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Cotton Seed Oil Industry

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THERE is a widespread prejudice against the crushing of cotton seed in India, and milch cattle are still fed with whole cotton seed This is wasteful, a large part of the fat in the seed is not assimilated by the animals and is excreted[1] Feeding experiments in western countries have revealed that for the nutrition of milch cattle only small quantities of certain unsaturated fatty acids are required In the case of oil cakes which are unsuitable for animal feed and are used as fertilizers, the lesser the oil content of the cake, the better the value as a fertilizer It is, therefore, evident that cotton seed cake which still retains a small quantity of oil is rich in protein and is eminently suitable both as a cattle feed and as a fertilizer

Recent investigations at the Cotton Cess Committee's laboratories at Lyallpur on the nutritive quality of cotton seed cake reveal that of all the oil seed cakes employed as cattle feed, cotton seed cake is the cheapest from the point of view of starch equivalent and assimilable proteins[2] Cotton seed cake flour is finding increased use in human dietary Under the trade name "Alison flour" it is used in admixture with wheat flour, and the combination is 25 times as nutritious as an equivalent quality of potato flour, 5 times as nutritious as corn meal and 4 times as nutritious as oats meal

The *per capita* consumption of oils and fats in India has been estimated by the Food Ministry of the Government of India at 8 lb per annum, as against the normal nutritional requirement of 45 lb If the *per capita* consumption of fat is to be raised, it is necessary that efforts should be made to increase the production of edible oils by crushing oil seeds such as cotton seed which are now being wasted

India produces at present over 2 million tons of cotton seed per annum out of this quantity 3 lakh tons are crushed for oil and 2 lakh tons are used for planting A part of the remaining quantity is exported and the rest fed to cattle If all the available cotton seed is crushed, the production of vegetable fats can be increased without having to bring more land under oil seed cultivation In California, where cotton seed processing is a major industry, the oil is refined and used for the manufacture of margarine Cotton seed oil is also largely used in soap manufacture

If the cotton seed oil industry is to be established in India on a commercial scale, the processing should be economical and the products should conform to the trade standards In case the residual cake after the extraction of oil is not accepted as a cattle feed, it will have to be utilized as manure and sold at a low price[3]

The toxic phenolic substance, gossypol, present in cotton seed cake and its removal have formed the subject of a great deal of research It has been suggested that cooking of cotton seed meal renders gossypol inactive, and the resulting meal is suitable for animal and human consumption

The China Vegetable Oil Company, Shanghai, is producing petrol and Diesel oil from cotton seed oil From 100 lb of oil, 24 lb of motor fuel and a large quantity of lubricant are produced

The storage of cotton seed demands particular attention The cotton ginning season is comparatively short, and the seed collected has to be stored for the rest of the year Investigations on storage and respiration show that cotton seeds with a high moisture content (exceeding 8 per cent) respire vigorously, develop free fatty acids and deteriorate rapidly[4] Seeds intended for storage should be dried, and temperature and humidity conditions in storage sheds should be controlled Commercial seed conditioners and dryers for controlling the moisture content to the required degree are available

Processing of cotton seeds for oil extraction involves, as the first step, cleaning of seeds in a combined pneumatic and mechanical cleaner for separating dirt, sand and other impurities The closely adherent fibrous coat is removed by a carver or other type of delinting machine of modern design The seeds are decorticated or hulled and the kernels separated from hulls with the help of shaker screens and aspirators The kernels are coarsely ground in a roller mill and crushed in an Anderson expeller provided with a cooling system The residual cake contains less than 4 per cent oil

During the past few years solvent extraction processes have been employed in the United States of America for obtaining cotton seed oil Direct solvent extraction, however, presents many serious difficulties, and processing by the combined use of expeller and solvent extraction has proved not only advantageous but also economical

In planning a cotton seed oil mill it is essential to consider a number of factors which influence both its design and operation Included among these are optimum capacity, supply of raw material, transportation facilities, power and water supply, and storage space Plant economies dictate the necessity for continuous operation of a minimum of 300 days per year Full-time operation is especially desirable since trained and competent operating personnel cannot be had on a part time or seasonal basis The economy of a 75-ton capacity cotton seed oil mill by the expeller process can be gauged readily from the estimates given below

ESTIMATES FOR A 75-TON COTTON SEED OIL MILL ON 24-HOUR DAY BASIS

A CAPITAL

		Rs	a	p
1	Oil mill machinery viz cleaning delinting crushing with ancillary units	9,00 000	0	0
2	Oil refining plant	2 00 000	0	0
3	Auxiliary plant viz steam power and water cooling towers pipe line, etc	2 00,000	0	0
4	Erection, etc	2 00 000	0	0
	TOTAL	15 00 000	0	0

B COST ESTIMATE

		Rs.	a	p
1	*Raw Materials* — 75 tons cotton seeds at Rs 25 per ton	18,750	0	0
2	*Utilities* —			
	(a) 75 000 lb process steam equivalent to about 5 tons of coal at Rs 40 per ton	200	0	0
	(b) 12 000 kWh of electricity at 1 anna per unit	750	0	0
	(c) 35 000 gallons water	35	0	0
	(d) 3 cwt of caustic soda at Rs 33/- per cwt	100	0	0
	(e) 4 cwt of Fullers earth at Rs 35/- per cwt	140	0	0
	(f) 2 cwt of activated carbon at Rs 70/ per cwt	140	0	0
3	*Labour, Supervision and Overhead Charges*	300	0	0
4	*Amortisation value* at 10 per cent over Rs 15 00 000/- capital equipment at 300 working days per year	500	0	0
5	*Amortization value* at 5 per cent over Rs 5,00 000/- over building and godown	80	0	0
6	*Mill stores, repairs and maintenance* at 2 per cent over capital cost of machineries	100	0	0
	TOTAL EXPENSES PER DAY	21,095	0	0

CREDIT FOR SALES PROCEEDS

		Rs.	a	p
1	10 tons refined oil at 13 per cent overall recovery at Rs 1 500/- per ton	15 000	0	0
2	0 75 tons soap stock at 1 per cent yield at Rs 400/- per ton	300	0	0
3	1 5 tons linters based at 2 per cent yield at Rs 400/- per ton	600	0	0
4	30 tons hulls based at 40 per cent yield at Rs 60/- per ton	1,800	0	0
5	28 tons cake based at 37 per cent yield at Rs 170/ per ton	4 760	0	0
	TOTAL	22,460	0	0
	PROFIT PER DAY	1,365	0	0

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REVIEWS

Elastomers and Plastomers, Part II Manufacture, Properties and Applications, edited by R Houwink (Elsevier Publishing Co Ltd, New York, Amsterdam, London, Brussels Cleaver-Hume Press Ltd, London), 1949, pp xvi + 515 Price 50*s*

THIS VOLUME FORMS PART II OF ELSEVIER'S comprehensive treatise on " Elastomers and Plastomers " of which Part III was recently reviewed in this Journal (Vol VIII, p 194, 1949) It contains, besides a detailed table of contents and an exhaustive index, thirteen chapters, one on each of the following topics phenol formaldehyde resins (including aminoplasts), synthetic resin ion exchangers, urea and melamine resins, polymers from ethylene derivatives including allyl compounds, cellulose derivatives, protein plastics and fibres, synthetic polyamides, silicone polymers, alkyd resins, natural resins and their derivatives, derivatives of natural rubber, synthetic rubbers, and asphalts, which thus cover the whole field of natural and synthetic high polymers

The topics are treated in a comprehensive and authoritative manner in respect to their chemistry, industrial preparation, properties and applications The chapter on phenolics may serve to illustrate the point It begins with the industrial production of the raw materials (phenol, cresols, aniline and aldehydes) and then deals, in succession, with the chemistry and reaction kinetics of condensation polymerization as applied to phenolics, with resins for varnishes, paints and lacquers giving individual preparations, properties and applications, with resins used for adhesives, moulding compositions including resins for jet moulding, and finally with resins for laminating purposes, the whole treatment being based on sound theoretical principles and accurate technical details of facts illustrated with tables, diagrams and photographs, a list of references at the end completes the chapter A more or less similar procedure is adopted in the remaining chapters

Each chapter is written by one or two chemists of the research laboratory of the industrial company which is specializing in the production of the particular plastomers or elastomers in question Thus the chapter on urea and melamine resins is by two chemists of *Ciba Ltd*, Switzerland, which produces several of these resins and has done original work in the field The chemists of the Protein Research Division of *British Plastics Ltd*, and of *Courtaulds Ltd*, England, contribute the chapter on protein plastics and fibres A chemist of *Rohm & Haas Co*, U S A, writes the chapter on polymers of ethylene derivatives, and this company is not only producing acrylic and other vinyl resins, but has also done pioneer work in these plastics Silicones are treated by a chemist of *General Electric Co*, Schenectady, which first produced these resins It is natural that a chemist of *Du Pont de Nemours* should write about synthetic polyamides (nylons) Dr Houwink who has to his credit several books and articles on high polymers not only writes with authority on phenolics but is the editor of the three parts of this series on elastomers and plastomers

The book certainly gains much from the international character of the collaborating group of authors, but suffers a little just as any composition of composite authorship, from lack of uniformity in the manner of presentation Thus, in certain chapters like those on polyamides and silicones, the details of industrial production of the materials concerned are not too abundant maybe due to lack of published information or simply due to the tendency on the part of the authors to gloss over them The language of the non-English authors is, at times, not too clear or sufficiently idiomatic as in the following cases " the conception to which the aniline formaldehyde resins contain globular molecules has gained support " (p 17), " the products that form distinguish themselves from " (p 7), " the surprising moment was the fact " (p 112), " a far too driven condensation " (p 58), " herefore " (p 57), " at the time being " (ibid) and so on A little careful retouching could have eliminated these mistakes

The printing is good and the paper, too, is equally good But some typographical mistakes have been noted which are rather uncommon in Elsevier's publications These minor defects do not, however, detract in any way from the main value of the book which is a mine of carefully assorted scientific and technical data of wide variety and scope concerning high polymeric materials of industrial importance and which, along with Part I (General Theory) and Part III (Testing, Analysis Tabulation of Properties), would make an excellent and up to-date reference set The book should find a ready welcome at the hands of all who are interested in the scientific and industrial aspects of plastics, fibres and rubbers

L M YEDDANAPALLI

Tablet Making, by Arthur Little & K A Mitchell (Northern Publishing Co Ltd, Liverpool), 1949, pp 121 Price 15s

TABLET MAKING IS AN IMPORTANT AND AN indispensable feature of the modern pharmaceutical industry as tablets have become most popular owing to their elegance for single dose dispensation of solid medicines This device which is nearly a century old has now been perfected with the aid of the modern automatic tabletting machines which can turn out compressed tablets in great speed and in various sizes, shapes and colours There has been, however, very little information published so far by those who possess the "know how" of the process of tablet making and the present volume is, therefore, to be welcomed as a valuable publication on the subject

Little and Mitchell have written their book well and have adequately illustrated it The book furnishes detailed and comprehensive information on all aspects of tablet making including granulating, drying, compressing, colouring and coating It seems to have been written with an idea of giving practical guidance to those who wish to take up the manufacture of tablets and as such contains several useful "tips" in every process of tablet making Furthermore, the inclusion of a formulary giving the composition of about 25 typical tablets should also prove very useful in practice

Although there are possibly many other industries where the tabletting machines could be used, just only a mention has been made in the book of such possible uses This is because at present it is only the pharmaceutical industry which is making the compressed tablets on a very large scale and the other industries are yet to develop this line

On the whole there is no doubt that the book is a very useful practical handbook on tablet making and, therefore, should prove valuable not only for students of pharmacy but also to manufacturers of tablets in the pharmaceutical industry

H B S

Proceedings of the Rubber Technology Conference, London, 1948 (W Heffer & Sons Ltd, Cambridge), 1949, pp xxxii + 523 + xix Price £ 3/3

RUBBER TECHNOLOGY HAS ONLY RATHER recently received the recognition that has been its due for a long time The second Rubber Technology Conference of which the "Proceedings" is the record was the focal point for rubber technologists from various corners of the globe The information contained in this admirably edited "Proceedings" forms a very valuable contribution to the knowledge of rubber technology

The papers presented in this volume deal with the work done on various aspects of rubber during 1938-48 During this decade, as in practically every other realm of science, there has been unusual activity in the field of rubber technology Rubber industry can boast of substantial progress made during the war years It was the stress of war that accelerated the advent of synthetic rubber Although there has been a general tendency to brush aside synthetic rubber as a "war baby", many rubber technologists realize that the synthetic rubber industry has come to stay This realization is reflected in the "Proceedings" because the first session of the Conference was devoted to "Synthetic Rubbers"

In this first section all the more common synthetic rubbers — GR-S, Butyl, Buna N, Neoprene and Silicone — find their place Synthetic rubber is still in its youth, if not in its infancy, and as such we may expect to hear a lot more about these polymers

GR-S is the most common commercial synthetic rubber and perhaps the largest amount of work in synthetic rubber chemistry and technology has been done with reference to this polymer Yet Dinsmore, a veteran in this field, says in the first paper in which is given a comprehensive comparison between natural rubber and butadiene-styrene polymers, that " nothing could be more misleading than to create the impression that the quality of GR-S had reached a static position or we were fully informed as to how to use the material to the best advantage " This, in fact, summarizes the present status of synthetic rubber

Silicone is an interesting new-comer in this field " Unknown in 1938, Silicone rubber appeared in the American market in 1944 " — that is how Bass introduces Silicones in his paper The ability of this elastomer to retain its resilience and flexibility over a wide temperature range of —70°F to over 400°F has made it specially suitable for a variety of uses in electrical and other industries where resistance to extremes of temperature is required

Some of the information contained in this paper as also in the other four subsequent papers in this section has already been published in technical journals However, as reviews of work done on the various elastomers the papers are useful

The section on the chemistry of rubber gives some of the latest concepts regarding rubber-sulphur combination during vulcanization, and the action of oxygen on both raw and vulcanized rubber The structure of the rubber vulcanizate has been the subject of investigation right from the early days of the discovery of vulcanization Recently it has been shown that during vulcanization, sulphur can combine with rubber either by intramolecular cyclization or by intramolecular cross-linking Bloomfield has attempted in his paper to show the point of attachment of sulphur in these combinations According to the evidence so far obtained from experiments with olefines, the sulphur atom appears to be located between the α-methylenic carbon atom and a tertiary saturated carbon atom

An elegant technique developed by the Institut Francais du Caoutchouc for the measurement of the rate of oxidation of rubber is described in this section Some of the results of this investigation such as the variation in absorption of oxygen by different samples of the same rubber but purified by different methods require further clarification The most interesting aspect of the work is probably the portion dealing with the influence of three selected negative catalysts — phenyl-β-naphthyl amine, α-tocopherol, and zinc salt of mercaptobenzothiazole The first two anti-oxidants slow down the rate of oxidation of the rubber whereas the zinc salt of MBT shows a quite different behaviour — the sample containing this behaves almost as purified crepe rubber containing no anti-oxidants The explanation of this will have to await further experimental work

The rôle of oxygen in the mastication of rubber has been the subject of controversy for some time Direct determination of the oxygen content of a rubber sample would be valuable in following the action of oxygen For this purpose a method originally developed by Unterzaucher has been adapted by Chambers By combustion the oxygen in the sample is converted first into carbon monoxide, and then into carbon dioxide The latter conversion is effected using I_2O_5 and the iodine liberated in the process is estimated A relative accuracy of 2 per cent is claimed for this method

The section dealing with the physics of rubber is of considerable interest in several ways The study of the crystallinity of rubber has recently thrown much light on the tensile strength of vulcanized rubber Tensile strength is attributed mainly to the ability of the rubber to form crystallites when stretched Further work in this field combined with investigations on the nature of sulphur linkage in vulcanized rubber may prove to be of value in improving the methods of vulcanization

Many of the ideas regarding the physical properties of vulcanized rubber are changing Permanent set is now stated to be " not permanent at all " It entirely depends on the orientation of the filler particles when rubber is stretched

Rilvin's paper is sufficient to vindicate, if any vindication is necessary, the pursuit of fundamental research as applied to rubber In this paper is discussed the application of the elastic theory to many practical engineering problems

Testing and analysis of rubber appears to have received only a cursory attention This is all the more surprising when viewed against the fact that a great deal of development in this field occurred during the past decade, and that most of the methods so developed have not yet seen the light of publication The paper on the meaning of test results included in this section gives the impression that in spite of the significance of the interpretation of test results, this is becoming a rather over-preached topic

Rubber latex is generally described as an emulsion of rubber globules in aqueous serum But the isolation of a yellow fraction which is referred to as " lutoids " in a paper presented in the section devoted to latex changes the above conception The study of this yellow fraction assumes great significance because this fraction seems to be responsible for variability of latex, and also for its spontaneous coagulation Variability of latex has been a constant worry of latex goods manufacturers, and now there seems to be a possibility of eliminating the very cause of this trouble The drop in viscosity of latex observed on addition of ammonia is explained as due to the dissolution of the yellow fraction in ammonia It looks as though many more of the perplexing problems connected with latex are much nearer solution now As such, the importance of this paper cannot be over-emphasized

Most of the information contained in the papers on the coagulation of latex by sodium silicofluoride and the control of viscosity increases of compounded latex has been the subject of two similar papers read at the latex symposium held in Manchester in 1947

The development of synthetic rubber has given a great impetus to work on modifications of the natural rubber hydrocarbon In order to achieve the latter end, it is essential that the properties of the pure rubber hydrocarbon must be studied From this point of view, the paper on the " Preparation and Properties of Highly Purified Rubber " is an important contribution A new method by which rubber hydrocarbon of nearly 99 9 per cent purity can be obtained without resorting to any drastic chemical or mechanical treatment of the rubber is described

Of the two sections dealing with compounding ingredients, one section is devoted entirely to carbon black There has been no lack of theories on filler reinforcement of rubber It is now suggested that modulus type of properties of loaded rubber are determined mainly by the shape and concentration of the filler, whereas tensile-type properties are dependent on the size and surface characteristics of the filler particle

It has been generally agreed that the reinforcing ability of carbon black depends to a great extent on the surface activity of the carbon black particle The study of the surface characteristics is, therefore, important In a paper devoted to this subject it is stated that the electron microscope examination of the emission spectra of groups desorbed from carbon black has shown the presence of aldehyde, carboxyl, hydroxyl groups and many other chemical complexes The extension of this work may throw more light on the mode of carbon black reinforcement of rubber

The next section dealing with developments in factory processes since 1938 when the first Rubber Technology Conference was held is mainly concerned with the use of rayon as tyre cord High-tenacity viscose rayon is superior to cotton because rayon shows higher fatigue resistance, smaller tyre drag and better tensile characteristics at elevated temperatures Nylon and steel are also mentioned as tyre cord materials Although both these have been used in the construction of tyres, not much headway has been made One ply of steel cable is equivalent to about three plies of rayon fabric, and as such tyres made with steel cable are much thinner , and because of this such tyres show less tyre drag which depends, among other things, on the thickness of the rubber in the tyre

It is of interest to note that a tyre made of 100 per cent GR-S shows a rolling resistance 50 to 60 per cent higher than that of a typical tyre made of natural rubber

The " Proceedings " ends with an open discussion on certain physical properties of vulcanized rubber It is stated that the discussions were held to help drawing up of international standards It may not be too much to hope that the I S O would succeed in reconciling some of the conflicting views expressed during the course of the discussion regarding the methods of test and the presentation of results, and in bringing out standard specifications which would be acceptable to a large majority, if not all, of the rubber technologists

As pointed out in the foreword to the " Proceedings ", there is a paucity of papers dealing with aspects of rubber manufacture in which field a considerable progress was made during the war years This is attributed to " the brief time available for their preparation, and the proximity to the cessation of hostilities " Whatever be the reason, it must be admitted that the absence of such papers has, to a certain extent, decreased the usefulness of an otherwise valuable volume Even with this detraction in its value, it can still serve as a very useful companion to rubber technologists

G T Verghese

Welding Technology, by F Koenigsberger (Cleaver-Hume Press Ltd , London), 1949, pp viii + 280 Price 21*s*

" Welding Technology " by F Koenigsberger is undoubtedly a very comprehensive work on the subject It is evident from the author's point of view that in these days of specialization, one finds it hard to draw the line of demarcation between one subject and another For example, a welding engineer is called upon to have a general background of other branches of engineering such as mechanical engineering, electrical engineering, metallurgy, production engineering, etc Though, primarily, it is the business of the structural engineer to see that the welded structure has the required strength, the welding technologist cannot ignore this fact For, he should see whether the process involved in welding yields the desired result or not He should keep his mind alert on various problems cropping up from other branches of engineering in his day-to-day work

The author deals exhaustively with arc welding, gas welding and resistance welding The treatment of the subject has been thorough and systematic Having at his back years of industrial experience supported by good academic training, the author has brought home in this volume the many points that a welding technologist usually misses in his work The author has dealt the subject of welding under two heads, viz fusion welding and forge welding The former covers only that process involving additional filler metal, and in this process, the heat is generated invariably either by electric arc, or by gas or by chemical reaction In the case of forge welding, no additional filler metal is used, but the operation takes place under pressure and the heat is generated by ordinary blacksmith furnace, or by gas flame or electric current

The subject-matter is presented in seventeen chapters and a chart is also included at the end of the book for identifying the metals to be welded In the first three chapters a comprehensive survey of various types of welding is made, while in the subsequent chapters the welding of ferrous and non-ferrous metals is outlined

The chapters on plant and equipment for oxy-acetylene welding, arc welding and also for resistance welding are exhaustively treated, though an ordinary welder need not know these details But, after all, it is the duty of those connected with welding to put the welding machines and plant in working order when there is a break-down Hence the author is justified in treating this part of the subject in these chapters in the way he has done Flame cutting and gouging have also found a place in this volume, wherein he has outlined the technique on which the author claims to have some experience

In the last seven chapters of the volume, the author has included various topics which are directly or indirectly connected with welding technology as, for example, the chapter on " Design Principles " and " Drawing Office Procedure in Connection with Welding " At first sight it would seem as though this chapter can hardly find a place in a book like this, but when one goes through the book, it only shows the complete and thorough understanding of the subject by the author and the presentation of the subject is such that the reader would be fully convinced that there is not a word extra or superfluous in this volume other than the essential material

The author is extremely lucky to draw his knowledge from his father to whom he has paid homage The whole work looks as though the trait has been inherited

The reviewer feels that this book should be a valuable addition to the desk of any one, be he an apprentice or a professional welder or a foreman or an engineer , to the college student and an industrialist it should fill the place of a reference book

V Cadambe

Engineering Metals and Their Alloys, by Carl H Samans (Macmillan & Co London), 1949, pp xiii + 913 Price 37*s* net

This is an admirable book for students of engineering and metallurgy Its unique feature lies in the classification of alloys based on their application rather than on their composition There is a happy blending of information valuable alike to the engineer and the metallurgist

It opens with a chapter on the general characteristics of the metallic and engineering materials All the mechanical properties have been discussed and the standard tests including the magnaflux, radiographic, supersonic methods and fluorescent penetrants, etc , are described

In the next chapter, the structure of the pure metal has been discussed The author has enunciated the fundamental principles and has made this subject very lucid — especially the conception of grain size, space lattice, recrystallization and effects of hot and cold work on metals and alloys

The author has then dealt with the production of metals and alloys The production of pig iron and steel has been given briefly and the reader is not burdened with too much detail in this particular branch

The production of certain non-ferrous metals has, however, been very well dealt with A number of processes for the manufacture of magnesium has been described — the important ones being the Dow chlorine process, the electron process, the oxide process, Hansgirg process, Pidgeon ferrosilicon process, etc

In the case of aluminium, in addition to the common Bayer process, two more processes like the kalunite process for alunite and the Ancor process or lime-sinter process have been described

In the case of zinc also some modern methods have been discussed One is the *St Joseph Lead Company's* electro-thermic process used for the electro-thermic reduction of zinc and the other Waelz process in which residues containing a very small quantity of zinc are profitably and efficiently recovered by volatilization in a rotary kiln

The production of other metals has been discussed and information as given by other standard books has been incorporated

The most impressive chapter in the book is the chapter on the theory of alloys It has been ably written and amply illustrated with instructive diagrams The binary system has been dealt with at length and the ternary system which is receiving increasing attention in recent years has also been dealt with The author has explained in simple language the facts and phenomena which ordinarily are not readily understood by the beginner The structures, wherever necessary, are illustrated with microphotographs

One chapter has been devoted to the heat treatment of metals and alloys Various important treatments given to ferrous and non-ferrous alloys have been discussed and the theories of age-hardening have been given with modern views thereon

The chapter on shaping and forming the metallic materials has been dealt with systematically under various heads such as casting, extruding, hot working, adding or joining metal by means of soldering, brazing, welding, rivetting, flame cutting, machining, grinding, etc

Finally, the book deals with the most important alloys, both ferrous and non-ferrous They have been classified according to their applications Those alloys which can be easily fabricated like the brasses are dealt with first Then come aluminium alloys, gun metal, alloys having heat resistance, high strength, ductility, and finally are described tool alloys, like the high-speed tool steels The author has described these alloys under the various heads of manufacture, composition, properties, metallographic structure, effect on heat treatment and, finally, their industrial uses

The book is an excellent guide for those interested in metallurgy and the use of metallic materials As already pointed out, all the matter has been discussed both from the metallurgical and the engineering points of view

D Swarup

Patented Inventions of the Council of Scientific & Industrial Research

CONTAINERS FROM PLASTIC SHEET MATERIAL

Indian Patent No 32,824, British Patent No 6,26,963, U S A Patent No 24,84,656

B N SIKKA, G SINGH & L C. VERMAN

LAMINATIONS made out of cotton cloth, jute cloth, paper or like fibrous sheet material are impregnated with resin and pressed in a mould by means of a plunger having within it a spring-loaded secondary pilot plunger which pushes the laminations into the mould cavity prior to the entrance of the main plunger (FIGS 1 and 2) To the spring-loaded secondary plunger is attached an arrangement for locking the plunger after the mould is closed and also an arrangement for unlocking the plunger when the mould is opened The spring-loaded secondary plunger pushes the laminated blank ahead into the cavity in the mould before the confining edge of the main plunger comes into contact with the blank and thus the shearing of the blanks is avoided The clearance between the main plunger and the mould is varied by providing tapers in the main plunger and in the mould, the taper in the main plunger being kept at a minimum, while the taper in the mould is made larger to accommodate the excess gathering of the pressed material at the top of the article

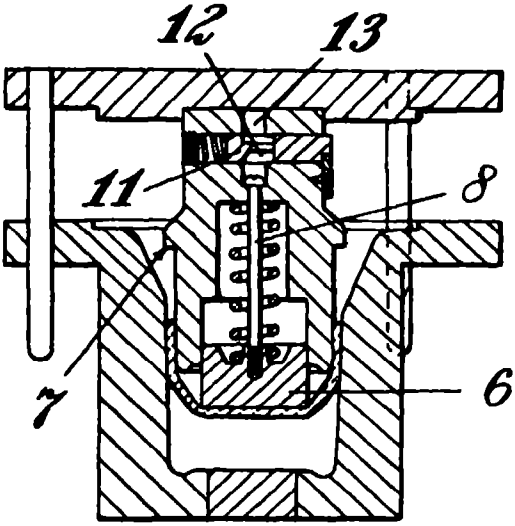


FIG 1

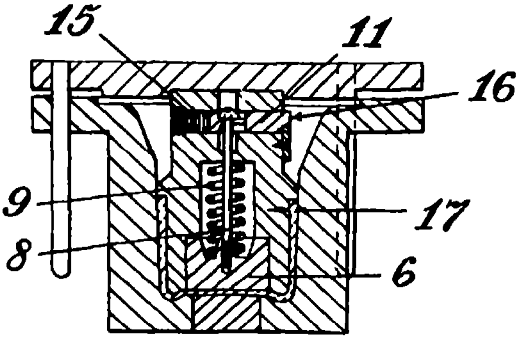


FIG 2

Fig 3 shows an alternative construction wherein the spring-loaded secondary plunger is provided in the mould part

The method is specially suited for the manufacture of cigarette containers, ash trays, ceiling rose covers, cups and the like deep mouldings

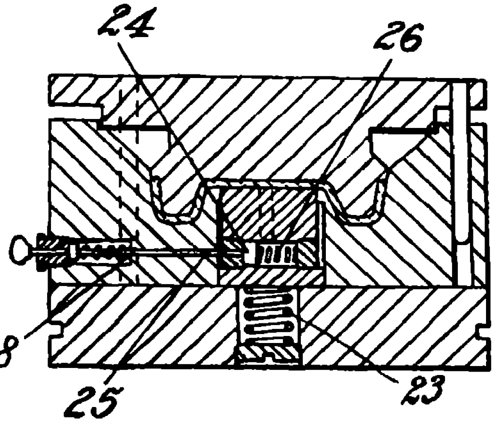


FIG. 3

Some Aspects of the Finnish Glass Industry

K D SHARMA

Central Glass & Ceramic Research Institute, Calcutta

THE Finnish glass industry, as a whole, is not strictly comparable with that of the U K or the U S A The demand for bottles and containers being limited to the home market, the industry has specialized in the manufacture of cut and engraved glass and high-quality table ware Both automatic and semi-automatic methods are used in their manufacture

Of the four well-known glass works, the factories at Karhula and Riihimekki produce pressed and blown ware, various types of container ware, building blocks and decorated glass, the factory at Iittala makes table ware and art glass, while the Lahti Glass Works have a Fourcault sheet-glass plant The present article deals with some of the production practices employed at the Karhula Glass Works

Karhula Lasitehdas

The factory produces container ware of colourless and amber glass by automatic and semi-automatic machines, building blocks and cheap table ware by semi-automatic presses, glass wool by centrifugal process, and high-class decorated cut and engraved ware from potash and crystal glasses A few artists possessing outstanding ability and originality in the field of designing have made the Finnish glass industry famous and have earned a name for themselves Most of the first quality hand-made glass is at present exported to the U S A

Raw Materials

There are no suitable deposits of glass-sands in Finland Sand required for colourless glass is mainly imported from Holland and Belgium For amber glass, a mixture of Finnish and Dutch sands is used

Glass-house pots and some of the refractories are made in the factory from German clays, though most of the refractories for tank furnaces are imported from the U K and the U S A

Batch Mixing

Mixing is effected in small mechanical batch-mixers Batch is usually mixed dry but at Lahti a little moisture is added to it The dry batch is charged into the mixer which revolves for about a minute, a little water is then sprinkled on to the batch and the mixing carried on for another minute or two This is reported to give better mixing and prevent segregation of different-sized particles during handling, it also permits a dust-free charging into the furnace

Furnaces & Fuels

Pot furnaces are mostly of Siemen's regenerative type or Teisen's recuperative type Open pots are used for melting colourless, opal and coloured glasses from soda-lime and lead-potash batches Tank furnaces are small, melting from 12 to 20 tons of glass per day per furnace The recuperative furnaces are mostly fitted with Teisen patent recuperative tubes Thermocouples are inserted in the crown over the melting, refining and working zones Temperature measurements of the incoming producer-gas, preheated air and waste gas at the base of the chimney are recorded Analyses of fuel gas and waste gas are carried out regularly

As there are no coal deposits in Finland, producer-gas made from wood is the chief source of heat supply for the glass industry When imported coal is available, a mixture of coal and wood chips constitutes the charge in gas producers which are water-sealed and are of the stationary or revolving type There is no clinkering when wood is used The gas is free from oxides of sulphur and allows melting of even full crystal glass in open pots

The wood used at the sheet-glass factory contained 30 to 35 per cent moisture which lowered the temperature of the issuing gas to 160° to 200°C To enrich the gas, a little fuel oil was allowed to drip in the gas producer The calorific value was about 1300 cal per cu m of gas

Melting by Electricity

Finland has plenty of cheap hydro-electric power and much of the glass melting at Karhula is done by electricity

There are 2 recuperative tank furnaces for melting colourless glass which are heated by oil-electric and gas electric combinations, while a third one heated by electricity melts amber glass for bottles

The electric furnace has a definite advantage over combustion furnaces because of its higher efficiency on smaller tonnage and better performance for coloured glass The resistance of glass is taken advantage of, and heat is injected directly into the body of glass There are no chimney and regenerator losses and the throughput of the tank is not limited by the amount of heat that can be passed by radiation from the crown and the flame into the glass Current consumption per kg of glass is usually less than one kWh In a tank furnace using gas or oil in combination with electricity, the melting rate is about 30 per cent higher than in a tank of the same dimensions using only gas or oil In addition, there is better temperature control and the glass produced is more homogeneous and of better quality

A new Cornelius patent electric furnace under construction at Karhula is designed to produce about 20 tons of amber glass per day The electrodes are of soft Swedish iron containing less than 0·05 per cent carbon and are made large so that the current density is low There are 3 sets of electrodes in the melting end of the furnace Each set consists of 3 electrodes, one on each side of the tank and the third placed centrally dipping into molten glass The flux line of the tank is made of Corehart blocks No crown is needed over the melting end as the glass batch which is fed from the top covers the melt uniformly like a blanket and prevents heat loss The working end has an insulated roof and is provided with an oil burner to heat up the surface layers of glass when necessary

Experience at Karhula shows that whereas colourless glass can be melted satisfactorily in the electricity *cum* oil or gas tank, it is difficult to thoroughly fine and decolourize glass in a tank running only on electricity The quality of amber glass and undecolourized glass, however, is definitely superior to glass melted in a combustion furnace

Hand-blown Ware

All decorative ware, crystal ware, good quality table ware, wine glasses, lamp shades, etc, are hand-blown Wooden moulds are generally employed for the production of quality goods Paste moulds are also used but are not common

The output per chair is considerably higher than that in the U K A team consisting of 3 men and 3 boys blows about 1200 thin tumblers of 10 oz capacity during a shift of 7 hours, while 4 men and 2 boys make about 600 wines with stem in the same time In the chair making wines, the headman puts the stem on and the footmaker puts the foot on Each worker — blower headman and footmaker — has his own gatherer

Tumblers are finished by burning off in a French single-head machine in which the article is held by a chuck in the inverted position The article is lowered in a revolving ring-burner with a number of jets One machine is sufficient to handle the production of at least two chairs As no town-gas is available, the fuel used is hydrogen and oxygen contained in cylinders

Grinding is carried out on 3-head horizontal machines using carborundum powder A drilling machine fed with carborundum powder bores holes in lamp shades and globes

Decoration of Finished Ware

(a) *Cutting* — Heavy fluting is effected by the old method of steel mill and stone using different grades of carborundum powder and water Artistic designs are cut by small carborundum wheels of various sizes

(b) *Polishing* — A felt wheel and pumice are used for an article with a shallow design while a cork wheel with pumice is employed for a ware which has been cut to a deeper and sharper surface For acid polishing, a mixture of hydrofluoric and sulphuric acids contained in lead pans is used Little or no sulphuric acid is necessary for high lead glasses, a 1 1 mixture is used for lime glasses The mixture is maintained at about 40°C and the time required to obtain a good polish is about a minute

(c) *Engraving* is effected with copper wheels of different sizes Linseed oil and emery powder are fed to a revolving wheel and the article is pressed against it

Production on Semi-automatic Machines

Various types of phials and bottles are made on Schiller-type suction and blow semi-automatic machines, and jars on press and blow machines These machines show a definite improvement on the original models and are light and easy to operate The workman attains high speed by a repetition of the same article, the production per machine being higher than seen anywhere else 2200 to 2400 pint beer bottles per shift is the usual output for a machine fed by two gatherers

Tumblers, dishes and building blocks are pressed in a multiple mould press machine which is rotated by a motor but is fed and worked manually The articles made are usually fire-polished before annealing The production is 4000 eight oz tumblers per shift

Cheap quality jugs are made in a single mould press After the article is taken out of the mould, it is attached to a punty and softened a little to make the lip The production is about 2000 jugs per press per shift

Production on Automatic Machines

Along with the semi-automatic machines are installed, around the working end of the same tank, a few Riorant machines of B and F types These machines are suitable for small-scale production of high-grade bottles They are simple and do not require large space or costly equipment for installation and operation One operator can easily look after 3 or 4 machines No automatic feeders are required as the machines are of the suction type The machine-head carrying the blank mould enters the furnace and sucks the required quantity of glass The ware formed is accurate in weight and capacity The production varies from 3 to 4 bottles per minute depending upon the size of the bottle

The Riorant machine is now also made with double-mould head, i e the head carries two moulds, thus increasing the output by 100 per cent

The trend of production at Karhula, as anywhere else is now towards employing fully automatic machines for the manufacture of containers and pressed ware A new "4-head Hartford I S machine' and a '12-mould PBL press and press and blow machine" are under installation These machines are useful only for large production and capital costs are high In addition to the cost of machines, moulds, feeders and forehearths, a well-equipped workshop manned by skilled and specially trained operators is essential Because of the large and continuous production, a regular and rigid check on the quality of raw materials, furnace operation, wear and tear of moulds and other equipment, annealing of ware, and homogeneity of metal has to be maintained for successful production of the glassware

Manufacture of Building Blocks & Glass Wool

Glass building blocks are made by pressing shallow, rectangular boxes on a semi-automatic press and then sealing pairs of these together to form the hollow block Flutes and prisms are

(*Continued on p* 35)

NOTES & NEWS

Peptide Synthesis

THE REACTION OF ACYLPHOSPHATE (the phosphoric group of which is bound in an ester linkage) with the amino group of a free amino acid at 37°C in aqueous solution of *p*H 7 4 to form the corresponding acylated amino acid is made use of in the synthesis of some true peptides (*Nature*, 1949, **164**, 576)

Phenyl carbobenzoxyglycylphosphate has been prepared by the reaction of carbobenzoxyglycyl chloride with disilver phenylphosphate Phenyl carbobenzoxyglycylphosphate reacts very rapidly with amino acids, forming the corresponding carbobenzoxyglycylpeptides, from which the free peptides can be obtained by catalytic hydrogenation Up to the present, glycylglycine, glycyltryptophane and glycylglycyltryptophane have been prepared in this way

An unusual feature of this method is that it permits the synthesis of oligopeptides without isolation of the intermediary products (dipeptide, tripeptide etc) by alternately adding the phenyl carbobenzoxyaminoacylphosphate and hydrogenating the resulting carbobenzoxypeptide All the operations are carried out in aqueous solution at 37°C and *p*H 7 4, the yields are high, even in M/100 concentration of both the reacting substances

From the biochemical point of view, the reaction provides a model of peptide synthesis, the interest of which is due to the fact that acylphosphates are believed to play an important part in peptide bond formation within the living cell It is to be noted that the reaction takes place under physiological conditions of *p*H temperature and concentration

Synthesis of Chromones & *Iso*flavones

THE INTERACTION OF *o*-HYDROXYPHENYL benzyl ketones with ethyl orthoformate in boiling pyridine containing a little piperidine gives *iso*flavones Thus α-naphtha*iso*flavones is obtained from 2-phenylacetyl-l-naphthol, and 7-hydroxy*iso*flavone from 2 4-dihydroxyphenylbenzyl ketone in excellent yields The ethyl orthoformate condensation can also be effected in acetic anhydride and zinc chloride but under the conditions so far examined yields are poor With 2 4 6-trihydroxyphenyl benzyl ketone, ethyl orthoformate gives deeply coloured, complex condensation products With 2-acetyl-l-naphthol, naphthachromone is obtained, together with a bright-yellow by-product, m p 160°C (*Curr Sci*, 1949, **18**, 373)

Vanadium Pentoxide Sols.

THE PREPARATION OF RELATIVELY pure vanadic acid system from ammonium vanadate (than that obtained by the usual method, involving addition of an acid to ammonium vanadate), by ion exchange method is described (*J Franklin Inst*, 1949, **248**, 251)

Two exchange resins, Amberlite IR-100H and Dowex-50, are employed in the preparation of the sols In sol I a weighed amount of C P ammonium vanadate, 1 497 gm, was mixed with 10 c c of water and 15 0 gm of air dried amberlite IR 100H The paste was stirred until it acquired a deep-red colour This occurred in about 5 min 190 c c of water was added with rapid stirring The system had the deep colour characteristic of vanadium pentoxide sols It was filtered and analysed for ammonia and vanadium In sol II a weighed amount of ammonium vanadate, 21 1688 gm, was mixed with 1 litre of water and 300 c c of wet Dowex-50 The system was stirred for 1 hr, filtered and the sol analysed The coagulation data revealed that the particles were negatively charged An excess of resin was required for the production of a stable sol Calculated amounts of reactants yielded a precipitate because of the coagulating action of ammonium vanadate present in the equilibrium system Excess resin, however, contributed to the low yield of vanadium pentoxide in the sol Other factors influencing the low yield of vanadium pentoxide in sol II were the absorption of pentavalent vanadium and the greater exchange capacity of Dowex-50

Separation of Fatty Acids

A NEW FRACTIONAL DISTILLATION plant for the separation of fatty acids has been recently erected in a Lancashire factory (*Chem Age*, 1949, **61**, 410) The technique is very similar to that of petroleum fractionation and takes place in fractionating towers constructed of stainless steel which give off 4 fractions containing an overhead fraction including odour and unsaponifiable matter, acids of medium boiling point acids of high boiling point and a residue The plant is heated by Dowtherm and is controlled by an elaborate system of instrumentation High vacuum and close control of the heating ensure that the products are not decomposed at the high temperatures involved

The process will produce fatty acids ranging from C-8 to C-22 of up to 90 per cent purity The unsaturated products will, in some cases, be mixed, since the process does not separate acids of the same carbon chain length

Removal of Oxygen from Gaseous Mixtures

A CONVENIENT APPARATUS FOR removing traces of oxygen from gaseous mixtures is described (*Canadian J Res*, 1949, **27**, 299)

A pyrex glass tube (No 172), about 70 cm long 16 mm inside, 20 mm outside diameter, is drawn at one end to a tip suitable for connection to rubber tubing The tube is well packed with copper oxide wire fragments which are held in place by rolls of copper gauze The greater part of the length of the tube is wrapped with two layers of thin asbestos paper and then wound evenly, 3 to 3 5 turns per cm, with nearly 40 ft of nichrome wire, 2 ohms per ft The tube is further protected with more asbestos layers One or two turns of the nichrome wire and asbestos cord are spaced widely, and the layers of asbestos paper are cut away except under the wire, before applying the asbestos paste to the remainder of the tube This provides spaces which enable the condition of the copper in the tube to be examined The apparatus can be used with 110 volts d c or a c power source and temperatures of the order of 650° to 700°C are attainable To reduce the copper, hydrogen mixed with a carrier stream of nitrogen or inert gas is passed through the hot tube and this is continued until the tube has cooled down

New Industrial Viscometer

A NEW TYPE OF VISCOMETER FOR industrial use has been devised for the rapid determination of viscosity of a wide range of liquids (*Br Sci News*, 1949, **2**, 345)

A constant air pressure is developed in the instrument which forces the liquid under examination from a container into a horizontal glass capillary tube, open to the air at its far end The time taken for the liquid to pass between two points is proportional to the viscosity

The constant air pressure is produced by a dead weight gauge operating under conditions of low friction and producing a pressure (of the order of 60 cm of water) far below the lower limit at which conventional dead weight gauges can operate satisfactorily Pressure is maintained constant to ± 2 per cent

Each determination is carried out using a clean, dry calibrated capillary tube, 12 in long which is inserted into the viscometer head The cup containing the liquid is fitted into the viscometer head The cup containing the liquid is fitted into the taper on the other side of the head A "Snorkel" tube is then fitted to the capillary, at the end remote from the container, to prevent ingress of water and to allow exit of air when the viscometer is laid horizontally in a bath

To take a reading the piston is released and the time in seconds for the liquid in the capillary to pass the first to the second mark is recorded

The viscosity of very small samples can be determined using this new viscometer The volume of liquid used need not be known, and no density determinations are necessary The instrument is equally effective with clear or opaque liquids, and is suitable for viscosity measurements of volatile liquids The viscometer has a range of 50 centipoises upwards

Mosquito Larvae Mounts

AN EASY AND RAPID METHOD OF making permanent mounts of mosquito larvae in a simple medium prepared from indigenous materials has been evolved at the *Malaria Institute of India* (*Ind J Malariology*, 1949 **2**, 283)

The medium is prepared by dissolving at room temperature 50 gm of crystalline pine rosin in 75 c c of eucalyptus oil in a stoppered bottle The time required to dissolve the rosin completely is reduced from 48 hr to 2 hr by placing the container in an automatic shaker The solution is allowed to stand for a few hours and then decanted, after which it is ready for use For preparing the mount, the larvae are killed in hot water and put into 90 to 95 per cent alcohol or they may be directly killed in alcohol The specimens are transferred to fresh alcohol, absolute or 95 per cent, and kept in it for 15 to 20 min While under alcohol it is preferable to prick the larvae in the thoracic region in order to prevent their getting distorted or shrunk when mounted One larva at a time is placed in the centre of a slide and any excess of alcohol removed with a piece of blotting paper A few drops of medium are then placed and the specimen covered with a cover slip after arranging it in the desired position with the help of a needle In half an hour a transparent mount is obtained

The method obviates prolonged treatment of specimens for dehydration and other disadvantages in the use of Canada balsam and chloral gum as mounting media. The refractive index of the improved medium described (1 497) is comparatively lower than that of Canada balsam (1 524) with the result that even the very fine colourless structures like the retractile thoracic notched appendages of the Anopheline larvae, mounted laterally, are clearly visible This medium acts as a cleaning as well as a mounting agent which sets hard by itself within 2 to 3 days, without the slides being placed in an incubator It is not necessary to seal the edges of the mounts with any cement The medium has been found to be equally useful for unstained as well as stained objects and the larvae need not be completely dehydrated before they are mounted

This medium has been found useful for other insects such as fleas ticks, lice, etc Its consistency can be varied by adding more eucalyptus oil but it is advisable not to increase the percentage of rosin in the solution as the latter is apt to crystallize if the slide is heated for quick drying

Alkali Lignin

AN ALKALI SOLUBLE LIGNIN DERIVATIVE, free from sulphur, has been

INDUSTRIAL TARGETS FOR 1950

The following targets of production for the year 1950 have been suggested by the Ministry of Industry and Supply, Government of India for 15 basic chemical and consumer industries These targets have been communicated to the various industries for consideration and implementation by production committees which have been set up for each industry

Industry	*Target for* 1950
Coal	31 million tons
Steel	1 0 million tons
Cloth	45,000 million yards
Sugar	12 lakh tons
Sulphuric acid	1 million tons
Superphosphate	50,000 tons
Aluminium	3,500 tons
Cycle tyres and tubes	6 million sets
Motor tyres and tubes	1 million sets
Power alcohol	10 million gallons
Paper and paper board	110,000 tons
Glass	100,000 tons
Refractories	225,000 tons

obtained as a by-product from the sulphate pulping of *Eucalyptus regnans* (*Aust J Sci Res*, 1949, **2**, 117)

From the dioxan-ether mother liquors obtained in the isolation and purification of thiolignin from crude lignin (200 gm), the last traces of thiolignin were removed by concentration and precipitation with ether After removal of the precipitate (a mixture of thiolignin and alkali lignin, 32 gm) and working up the filtrate, alkali lignin (38 gm) was obtained as a fine light-buff powder Concentration of the mother liquors and precipitation yielded a second crop, darker in colour (9 gm) This was combined with (32 gm) mixed alkali lignin and thiolignin and refractionated, yielding a further crop of thiolignin (24 gm) and alkali lignin (8 gm) After purification from chloroform-ether to petroleum ether the purified alkali lignin was obtained (40 gm) This was found to have a minimum molecular weight of 1760 and is in agreement with the empirical formula $C_{92}H_{104}O_{34}$ (1754) The molecule contains 14 methoxy and 8 hydroxy groups Of the latter, 6 are sufficiently acidic to react with diazomethane, and consist of 1 carboxyl, at least 1 enol, the remainder being presumably phenolic There are 2 alcoholic hydroxyls, 1 primary and 1 tertiary

The alkali lignin is a fine powder with a lower softening point (112°C) than thiolignin (239°C) It is much lighter in colour, yellow when freshly prepared and fading on standing, to a light buff It is also higher in methoxyl content, 24 7 per cent, compared with 21 1 per cent méthoxyl for thiolignin Potentiometric titration gives a curve of the same type as that obtained with thiolignin, having two points of inflexion — occurring at *p*H 7 0 and 6 5 — and showing an equivalent weight of 863 compared with the value of 665 found for thiolignin

New Coking Process

THE DISCOVERY OF 2 NEW METHODS for producing high-grade coke has made possible the full exploitation of 8,000 million tons of Norwegian coal on Spitsbergen (*Chem Age*, 1949, **61**, 491)

When thawed for coking with the traditional methods, the coal disintegrates (on account of the prevailing low temperatures), making it unsuitable for firing One new method is to crush the coal to a fine powder and then make it into briquettes under heavy pressure The other method is to bind the coal together by means of concentrated sulphite-lye from the cellulose factories The latter method has the advantage that the coal need not be crushed so finely, and consequently pressing machines of simpler construction can be used

It is estimated that a plant processing 1 5 million tons of coal can produce 7,00,000 tons of ash-less coke briquettes, 1,30,000 tons of low-temperature tar, and 70 million gal of petrol plus diesel oil This would require 3,00,000 kW of power a year The high-temperature coke thus produced is very strong and far more reactive than ordinary high-temperature coke It can be used with great advantage both as a reducing material in all kinds of metallurgical processes and as a smokeless fuel for domestic heating The by-products of coking, tar and gas, are both readily usable in industry The gas can be used for chemical synthesis, especially of motor fuel

Extrusion Method of Butter Manufacture

A UNIQUE METHOD OF MANUFACTURING butter is being tried in Australia with a new Australian machine (*Agri Newsletter*, Australia)

The method involves the use of extreme cold extrusion instead of churning Milk is handled in the usual way until after it passes through a separator Then the cream is piped to a special cream separator, which divides it into 80 per cent butter fat and 20 per cent butter fat skim Butter fat is carried to a vat which standardizes it for salt and moisture content During the process a portion of the skim is fed back into the butter fat Then, under vacuum pressure, the butter fat enters the extruder where, in a brine solution at a temperature below zero, it is transferred into butter The butter comes out of the machine at 30°F

Suppression of Radio Interference

The British Electrical & Industries Research Association have reported in a recent pamphlet work relating to the suppression of radio interference from electrical appliances and motor vehicles An interference field-strength measuring equipment developed by the Association has been accepted as a provisional standard for interference measurements

Interference to radio reception from motor vehicle comes entirely from the ignition system The layout and design of the system has been modified and effective suppressors with resistors inserted in the high-tension leads have been designed on economical lines A single resistor of 5,000 to 10,000 ohms in the lead from the ignition coil to the distributor and with the coil mounted on the engine block has been found to give satisfactory interference suppression in the majority of cases Additional suppression can be achieved by insertion of resistors of similar value at the sparking plugs Where, however, the maximum degree of suppression is required as, in the case of military vehicles and aircraft carrying very sensitive radio equipment, screening of the ignition system may be essential Controlled tests have shown that, in general, resistors of values very much higher than those envisaged for suppression have no effect on engine performance and petrol consumption of the average motor vehicle

Apart from interference from motor vehicle accessories, the studies cover power-operated domestic appliances, industrial and high frequency equipment

Welding of Thermocouples

THE USUAL THERMOCOUPLES CONSISTING of copper, constantan, nickel and nichrome cannot be used on engine pistons because of the high incidence of breakage on account of low elasticity of these materials Even the best couple consisting of annealed steel and constantan for temperature measurements of high-speed Diesel engines (1,500 r p m) makes the welding difficult in an ordinary voltaic arc, as the steel oxidizes The essential features of a simple and suitable apparatus invented in Russia for use on engine pistons are described (*Science*, 1949, **110**, 308)

One of the poles of the source of current (d c is preferable) is connected to the terminal through a fuse, knife-switch and resistance The other pole is connected to a wire dipped into a vessel containing mercury and oil To weld the couple, the ends of the wires are twisted into a knot, the free end of one of the wires being connected to the terminal The knot is then dipped into the mercury and rapidly withdrawn For an instant an arc is formed between the mercury and the wire knot while the latter passes through the oil, and this arc welds the tips of the wires together An excellent joint is produced as the process takes place in a complete absence of air Wires of 0 05 to 2 0 mm diam can be welded by this method

Prevention of Corrosion

A NEW METHOD OF INHIBITING corrosion effects of hydrogen sulphide produced by anaerobic bacteria is described (*Chem Age*, 1949, **61**, 494)

During studies on substances which might prove satisfactory inhibitors, consideration was given to dyestuffs which were likely to be non-corrosive and possibly effective in very small concentrations Tests on the resistance of mixed cultures of sulphate-reducing bacteria to a large variety of dyestuffs showed that dyes of the flavine type are very effective Some derivatives of 3 6-diamino-[illegible]ridine were prepared by *I C I*, and the dye, known as *I C I* 914, proved extremely efficacious for the inhibition of such bacteria Experiments conducted to estimate the concentration of dye required to inhibit the growth of sulphate-reducing bacteria in varying degrees of infection, and practical use of the dye show that 1 lb of the dye per 100 tons of water is usually sufficient to control anything but the heaviest infections if used on successive occasions, the number of dosages being a function of the degree of infection

These investigations indicate that while control of the distinctive results of bacteria-produced hydrogen sulphide is not generally practicable in open systems (ships' condensers, etc.), protection can now be secured in many closed systems containing limited quantities of water

Preservation of Biological Specimen

THE DEVELOPMENT OF A CRYSTAL-clear resin, bioplastic, has greatly simplified the technique of preserving and studying biological specimens as pig embryo, jelly fish, human foetus and cross-section of human body The specimens can be studied from any angle with the naked eye and under the microscope and can be preserved indefinitely

To prepare the mounts, the specimens after being stained and treated with chemicals, if necessary, are placed in rows in a dish containing two layers of plastic, liquid on top, hard on bottom Specimens sink through liquid upper layer which soon solidifies, surrounding them with a hard, transparent covering The dish is placed in an oven for 3 hr to allow the plastic to set Blocks are then cut out with a fine-toothed bandsaw, each containing a single specimen These blocks are sanded and polished

Saffron Thistle Oil

OIL SUITABLE FOR USE AS A substitute for linseed oil in paint manufacture has been found in the saffron thistle in Australia The thistle yields 20 gal of oil to a ton of seed (*Technical Newsletter*, Australia)

Indian Standard for Plywood

THE DRAFT STANDARD PRESCRIBES the requirements for 4 grades of commercial plywood and does not include plywood for special purposes such as aircraft, marine-craft, tea-chests, etc It lays down definitions of terms used in the trade, species of timber that are to be used for the different grades of plywood, the requirements of adhesives, method of manufacture, and dimensions and finish of the various grades Tests for moisture content, for adhesion, and for resistance to moisture, and mycological test have been included Methods of marking, stamping and delivery of plywood are also given

Comments on the standard will be received by the Director Indian Standards Institution, till February 12, 1950

Central Research Laboratory, Hyderabad

THE FOUNDATION-STONE OF THE *Central Laboratory for Scientific & Industrial Research* was laid on 6th November 1949 The Laboratory will work in close collaboration with the National Research Laboratories of the *Council of Scientific & Industrial Research*, and will devote attention to urgent regional problems of Hyderabad The plan of the Laboratory has been drawn upon the basis of the National Research Laboratories in India and other countries, taking into consideration the special regional requirements of the Hyderabad State

The buildings will consist of a main block and a few auxiliary units The main block will house the offices of the Director and his administrative staff, general laboratories and special laboratory units, library, lecture hall, stores, common room and refectory In addition to the laboratory units, the main building will have a museum

The work of the Laboratory will be under 4 divisions — fuel, oil, analytical and general research

The annual recurring expenditure is estimated at Rs 3,75,000

Radio Research Laboratory

PLANS FOR THE ESTABLISHMENT of an up-to-date radio laboratory attached to the Engineering College, Poona, costing over 2 lakhs of rupees, is expected to be ready by June 1950 Two similar laboratories are functioning at the Indian Institute of Science, Bangalore, and the Guindy College of Engineering Madras The laboratory will have a separate control room, studio, transmitting and receiving stations, with facilities for television and frequency modulation The line communication section of the laboratory would have an automatic telephone exchange and equipment for picture transmission by wire, while the testing laboratory for carrying out standard tests of equipment used in line and radio communication would have all instruments according to the requirements of the Institute of Radio Engineering for British Standards A special ultra-high and micro-wave laboratory forms another important feature of the laboratory where research work on radio location would be carried out

Sugar Research Foundation Award

THE $25,000 GRAND PRIZE OF the Sugar Research Foundation [illegible] will be awarded on or about March 15, 1950 Following the awards of 1946, 1947, 1948 and 1949, established by the Foundation to stimulate scientific studies

of sugar as a food and as industrial raw material which may lead to its greater usefulness, the Grand Prize will be given for the most significant discovery of the preceding five years

Central Advisory Board on Forest Utilization

THE BOARD HAS BEEN RECONSTITUTED with a view to co-ordinating research on forestry with the needs of industry and agriculture and to ensure closer and more active liaison with public opinion The reconstituted Board will provide representation for industry, agriculture and consumers Its functions will be (i) to advise on the assignment of priority to various items of research conducted at the Institute, (ii) to co-ordinate research with the needs of industry, agriculture and the general public, and (iii) to link research with the needs of the producer and the consumer

Indian Showroom in San Francisco

TO STIMULATE EXPORTS OF INDIAN manufactured articles, especially to hard currency areas, it has been decided by the Government of India to open a showroom for Indian goods in San Francisco Attached to the Indian Consulate-General, the showroom will, in the first instance, accept only Indian handicrafts and cottage industry products Interested Indian manufacturers should contact the Director of Exhibitions, Ministry of Commerce, 96 Council House, New Delhi, for details

Trade Exhibition in Japan

A FOREIGN TRADE AND INDUSTRIES Exhibition will be held in Kobe from March 15 to June 15 1950 The Indian Chamber of Commerce (Japan) Kobe, has advised that it would be advantageous for Indian manufacturers of commercial goods to take part in this exhibition Intending exhibitors are advised to contact the Indian Chamber of Commerce (Japan) Post Box 393 Kobe Japan, for details concerning terms and conditions

The Government of India will arrange for issue of the required export licences to intending exhibitors, who should communicate with the Director of Exhibitions, Ministry of Commerce, Government of India, 96 Council House, New Delhi, for this purpose

Announcements

Edwards A Deeds Fellowship — The Secretary, University College, Dundee (*University of St Andrews*), invites applications by 31st March 1950 for the Edward A Deeds Fellowship for research in Physical Science, viz Engineering, Metallurgy, Chemistry, Physics, Mathematical Physics, or any cognate subject The Fellowship which is tenable for 3 years is of the value of £750 1050 per annum according to qualifications and carries membership of the Federated Superannuation System for Universities The Fellow will have the status of a University Lecturer and may be required to do a limited amount of advanced teaching

Prof T M Harris, Professor of Botany and Dean of Faculty of Science, Reading University, England has taken charge of the Palaeobotanical Research Institute at Lucknow Prof Harris will act as an adviser on the future activities and research in the Institute

Journal of Experimental Cell Research — The International Society for Cell Biology is sponsoring a new journal — *Experimental Cell Research* 4 issues will be published annually and will include studies in experimental analysis, the organization, structure and activity of the cell and its sub units, including work on viruses and new methods in the field of experimental cytology

A New UNESCO Publication — *Impetus* has replaced the *Reconstruction Newsletter* The magazine, a monthly, will be the forum for presenting opinion and exchanging views on educational scientific and cultural development and reconstruction A new feature is the monthly award of an international book coupon worth $10 for the best discussion in the field

The American Society for Testing Materials will hold its Committee week and spring meeting in Pittsburgh from February 27 to March 3, 1950 The 53rd Annual Meeting will be held in Atlantic City from June 26 to 30, 1950

Publications Received

A Chemistry of Plastics & High Polymers, by P D RITCHIE, Clever-Hume Press Ltd, 1949, pp 271, price 25*s* net

Chemistry of Perfumery Materials, by R W MONCRIEFF, United Trade Press Ltd, pp 344, price 30*s*

Canning Practice & Control, by OSMAN JONES, Chapman & Hall, 1949, pp 322, price 36*s* net

Modern Methods for the Analysis of Aluminium Alloys, by G H OSBORN & W STROSS, Chapman & Hall, 1949, pp 144, price 13*s* 6*d*

Industrial High Frequency Electric Power, by E MAY Chapman & Hall, 1949 pp 355, price 32*s* net

Indian Science News — Brochure on Penicillin, by DR S L BHATIA, Government College, Ludhiana, 1949, pp 71, price Rs 1/8

The Swelling of Wood under Stress, by W W BARKAS, His Majesty s Stationery Office, 1949, pp v + 103, price 6*s*

Modern Synthetic Rubbers, by HARRY BARRON, Chapman & Hall, 1949, pp xix + 636, price 45*s* net

Colloid Science — II, by H R KRUYT, Elsevier Publishing Co 1949, pp xix + 753, price 77*s* 6*d*

Ionization Chambers & Counters Experimental Techniques, by HANS H STAUB & BRUNO B ROSSI Mcgraw-Hill Book Co, 1949 pp 243 price $2 25

Chemical Engineering Plant Design, by FRANK C VILBRANDT, Mc graw Hill Book Co, 1949, pp 608 price $6 00

Mechanics Statics & Dynamics, by MERIT SCOTT, Mcgraw-Hill Book Co, 1949, pp 394, price $4 50

The Technique of Radio Design, by E E ZEPLER, Chapman & Hall, 1949, pp 394, price 25*s*

Analar Standards for Laboratory Chemicals, The British Drug Houses Ltd, 1949, pp 302

Technology of Light Metals, by ALFRED VON ZEERLEDER, Elsevier Publishing Co, 1949, pp xiv + 366, price $7 50

Physical Principles of Oil Production, by G P HERNWELL, Mcgraw-Hill Book Co, 1949, pp xv + 922

Multi-Enzyme Systems, by MALCOLM DIXON, Macmillan & Co, 1949, pp 101, price 7*s* 6*d* net

INDIAN CENTRAL COTTON COMMITTEE, 27TH ANNUAL REPORT (1948-49)

THE RESEARCH ACTIVITIES OF THE COMMITTEE'S technological laboratory and research stations in various provinces and states during the year under review show steady progress and valuable results have been reported in many fields

Improved strains of cotton have been developed with a greater yield per unit area and better quality of the lint A micro-spinning technique suitable for evaluating the spinning quality of small quantities of lint (12 oz) has been worked out, thus making it possible to select suitable strains which have been cultivated on a small scale

A standard ginning technique evolved for testing samples has been recommended for use at several cotton-breeding stations A balance of the steelyard type, which could be used for the rapid determination of the ginning percentage of small samples, was designed and constructed at the laboratory A modified type of Bardoli gin, in which seed crushing is practically eliminated, was fabricated during the period under report A new gin of the Macarthy type, which could be used at cotton-breeding stations for ginning small samples, is being designed at the laboratory

Tests were carried out on *Vijay* grown at different centres, on hybrids to replace *Jarilla* on *Gaorani* 6 of different generations grown with different doses of manure, and effect of exposure of cotton seeds to X-rays

Technological Research — Causes of abnormal spinning performance of certain Indian cottons having longer staple but spinning lower were investigated A study of optimum conditions for partial acetylation of cotton fibres to render them highly resistant to mildew and rotting without any appreciable loss in strength from micro-organisms indicated the following optimum concentrations of chemicals glacial acetic acid (75 per cent) 72 per cent acetic anhydride, 25 per cent, sulphuric acid, 3 per cent In addition several batches of chemical cotton were prepared from linters by the method specially evolved at the laboratory Many lengths of cellulose sheets had been produced by the viscose method and efforts are being made to make them fully transparent Besides, work is in progress on the spinning quality of mixings of Indian cottons with special reference to their fibre properties effect of agronomical factors on the physical properties of the cotton fibre and on the use of air permeability apparatus for determining the fineness of cotton The work of the scheme on the survey of cellulose-bearing materials in India, financed by the *Council of Scientific & Industrial Research*, was continued and a paper on the investigations on some promising cellulose-bearing materials (other than cotton) for the manufacture of rayon has been published A suitable standard technique for halolength determination is being evolved for adoption at all breeding stations

Fundamental research during the year dealt with the causes of chlorophyll deficiencies in cotton plants, lintless genes, evolution of substrains with uniform fuzz colour, effect of agronomic factors on the yielding capacity of the seed, vernalizations of seeds (prior to sowing) Agronomical investigations were connected with the study of the effect of crop rotation, nitrogenous manuring with inorganic and organic manures and addition of phosphate on soil fertility Nitrogen increased the yield significantly, although the difference in yield due to different sources of nitrogen was not quite significant Ammonium sulphate gave the best result followed by groundnut cake and farm-yard manure Phosphate applied in addition to nitrogen increased the yield significantly beyond the average of the yield from nitrogen and phosphate, applied singly Soaking of seeds in nutrient solution before sowing increased the yield of cotton over the control in all varieties although the effect is somewhat greater in indigenous varieties than in the American varieties Treatment with ammonium sulphate followed by mono-potassium phosphate (KH_2PO_4) shows the highest increase Inter-specific hybridization is being carried out at Surat to obtain hybrids from Asiatic and American cottons, with useful agronomic characters

Physiological Research — Field trials were conducted at Indore to study the effect of molybdenum, boron, copper, magnesium, iron zinc, manganese and chromium on the growth and yield of cotton The crops treated with zinc manganese and chromium were greener in appearance than the crops under other treatments and recorded an increase in yield varying from 20 to 25 per cent over the control The inter-relationships of sowing time, spacing and manuring on the growth and yield of cotton were determined on two soil types, viz (1) soils that become water-logged during monsoon and (2) well-drained deep soils The optimum sowing period was found to be between 25th May and 10th June for water-logged lands and 1st June to 20th June on well-drained lands Sowing on water logged lands gave poor yields Spacing of cotton was found to be an important factor in increasing the yield per acre ½ sq ft per plant equivalent to 9" between rows and 8" between plants or 12" between rows and 6" between plants has been found to be the optimum spacing The relation between sandiness of a soil and the magnitude of the response to manuring has been established The results with one exception indicated that wherever the soils contained more than 50 per cent of sand in the first 2 ft, a good response to the fertilizer was obtained

Cotton Research in Provinces — The area under improved varieties of cotton, mainly of medium and long staple types, was 51,48 000 acres or 47 per cent of the total cotton area as compared with 52 49,000 acres or 45 per cent of the total area in the previous year The proportion of cotton of staple length ⅞" and above to the total production increased from 30 per cent in the quinquennium 1922-27 to 64 per cent in the quinquennium 1942 47 The proportion of cotton of staple ⅞" and above (now termed as long staple) to the total production formed 18 per cent during the year under report as against 19 per cent in the previous year The Committee has recommended the adoption of improved varieties of cotton on a larger scale and has put into operation 13 seed distribution and extension schemes in various provinces. Additional benefit thus accruing to the growers is estimated between Rs 5 to 5 5 crores

Experiments were conducted during the year at Government Farm, Raichur, under the scheme for investigation of "small leaf" disease of cotton. Transmission of virus by several sucking insects was tested to see whether they were responsible for the transmission. A sub-committee appointed to examine the question of cotton production in the country, in view of the partition, has recommended the establishment of permanent cotton research stations in all the main cotton tracts of the country. These stations would carry out a survey of the areas to see that only the most suitable cotton strains are grown in those tracts and to ensure a proper supply of pure seed. An increase of 4 million acres under medium and long staple varieties in the various provinces has been recommended which raises the area under cotton from 11 million acres to 15 million acres.

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Cattle Breeding & Animal Nutrition

A COMPREHENSIVE POLICY REGARDING CATTLE-breeding in India was recommended at the annual meeting of the Animal Breeding, and Livestock and Milk Committees of the *Indian Council of Agricultural Research* held in November 1949. Special attention will be given to animals of the non-descript type with a view to upgrading both their milk and draught-resisting capacity. The Committee on Animal Nutrition recommended the establishment of the first regional Animal Nutrition Centre at Anand in Bombay province where all aspects of work on nutritional problems of livestock including research on grasses and fodder crops are proposed to be carried out on a regional basis.

Soil Conservation

The Scientific Committee on Agronomy and Development considered a new scheme on soil conservation in Himachal Pradesh. The protection of the area which constitutes the catchment areas of the rivers Jumna, Sutlej, Beas, Ravi and Chinab is essential on account of the Bhakra Dam Project and for the cultivation of fruits and vegetables. The scheme considered by the Committee aims at the introduction of suitable trees and grasses and to find a suitable technique for preventing soil losses from cultivation. A co-ordinated scheme of weed eradication by the application of synthetic chemicals was considered and approved. The scheme will operate in Madras, Bombay, U.P. and West Bengal.

The Committee has approved of a scheme for the trial of wind-mills for irrigation purposes at Allahabad, Ahmedabad, Belgaum, Travancore, Poona and Pusa to determine on a field scale the possibilities of harnessing wind power for irrigation of crops in areas having favourable wind velocities.

Fruit Research Station

The establishment of a Fruit Research Station at Simla with two sub stations at Bushair and Solan has been recommended by the Scientific Committee on Fruits and Vegetables. The proposed sub-station at Bushair will be used for cultivation of grapes and pomegranates. The dry and cold climate of Bushair is favourable for these fruits. The Committee also recommended that the Central Institute of Fruit Technology of the Ministry of Agriculture should be put on a permanent basis and should be properly equipped for giving technical assistance and advice to the fruit industry.

Various schemes of production of tuber crops were considered and among the new schemes approved by the Committee was one for breeding of high yielding types of tapioca and sweet potato in Travancore and Madras.

Cultivation of Medicinal Plants

The Medicinal Plants Committee has recommended commercial-scale cultivation of medicinal plants in India. Fifty important plants have been selected for cultivation on an experimental basis in different regions of the country. Six regions have been selected and, in each, one centre in the plains and another on a higher altitude are proposed. The centres suggested are the Simla Hills in Himachal Pradesh, Gurdaspur and Manali in East Punjab, Coimbatore and Nilgiris in Madras, Poona and Panchgani in Bombay, Darjeeling in West Bengal and Jorhat and Shillong in Assam.

The work under the scheme consists of trying the plants in the various centres in order to find out what particular varieties, climatic conditions and soil types would give the maximum yield of the active principle. On the basis of this information plantations will be developed for commercial cultivation.

COLONIAL PRODUCTS RESEARCH COUNCIL ANNUAL REPORT 1948-49

THE OPENING OF THE COLONIAL MICROBIOLOGICAL Research Institute at Trinidad devoted to fundamental research in microbiology was an important event in the Council's activities during the year. The Institute forms a part of Commonwealth scheme for the establishment of culture collections of micro-organisms which will be made available to other microbiologists.

Work on the re-use of rum distillery waste liquors in the preparation of fresh wort by treating the wash with 1 per cent superphosphate and neutralization during ebullition has led to the development of pure culture fermentation of molasses worts, and successful distillery trials have been made. Studies on the types of organism growing in the cocoa pulp during fermentation to determine their role in the development of cocoa flavour and chemical changes of pigments in cocoa bean during fermentation have been successfully followed up. 3 new anthocyanins, 2 leuco anthocyanins and a catechin have been isolated from the fresh Forestro bean. Soil antibiotics, related to litamacidin produced by certain actinomycetes, have been isolated from *Fusarium* infected soils. An actinomycete collected from Jamaica and Trinidad soils has been found to produce an antibiotic which arrests the growth of *Fusarium oxysporum cubense* and other fungi in dilutions less than 1 part per million.

Carbohydrates — One of the main items of the Council's research programme has been to find further industrial uses for sugar and starch. A large number of pyridazone derivatives prepared from levulinic acid (from sucrose) are being examined for their therapeutic value. Since the anhydrides of mannitol and sorbitol appear likely to be of value for the preparation of substances suitable for use in plastics industry, attention has been directed to a study of the structure of certain by products which are formed in the dehydration of the two hexitols and pyrolysis of mannitol and sorbitol formates One of the products of pyrolysis is 2 vinyldihydrofuran The interesting observation has been made that diallyl itaconate in admixture with polymethylmethacrylate yields a plastic which is superior in abrasive properties to that made from polymethylmethacrylate alone when used in the manufacture of dentures New and rapid methods have been devised for the isolation of 2 important *P* and *Q* enzymes Purified *Q* enzyme converts amylose to amylopectin This may prove to be of industrial value since it provides a method for the conversion of industrial starches into the non retrograding starches of the waxy maize type Another important investigation is the action of ultra violet light on starch A solution of starch exposed to ultra violet light is completely decomposed to give carbon dioxide Since other carbohydrates such as cellulose behave similarly and the reaction is obviously connected with the deterioration of carbohydrate material on exposure to sunlight the course of this photo oxidation is being studied

Vegetable Oils — Important studies on vegetable fats and oils have been conducted in Prof Hilditch s laboratory at Liverpool An oil with an iodine value of 205 to 207 and free fatty acid content of 0 9 to 1 6 per cent has been expressed from heat treated conophor seeds (*Tetracarpidium conophorum*) from Nigeria Heat treatment of the nuts checks the development of free fatty acids

The dispersion of about 1 per cent of rubber in the rubber seed oil expressed by usual methods has been removed by precipitation with acetone indicating thereby that rubber seed oil for industrial use will have to be solvent extracted with acetone and not expressed As in conophor nuts the heat treatment of rubber seeds also effects a check on the development of free fatty acids apart from facilitating their decortication when whole seeds are treated The component acids of the glycerides of groundnut niger seed safflower and tobacco seed oils have been examined

The Turkish tobacco seed having 35 per cent oil content yielded an oil resembling safflower seed oil in its high (73 per cent) linoleic acid content It is considered possible to roll the seed and solvent extract the oil The presence of a elaeostearic acid (30 per cent) in the fat of fresh *Parinarium laurinarium* seeds from Fiji has been confirmed and parinaric acid (51 per cent) has been shown to be octadeca — 9 11 13 15 — tetraenoic acid

An accurate method for the estimation of ricinoleic acid in castor oil has been worked out

The determination of the chemical constitution and component glycerides of conophor *Argentine* linseed Australia and Hong Kong candlenut and rubber seed has been completed This knowledge will enable paint manufacturers to obtain dryi oils suitable to their requirements and to utili them more economically

Medicinal & Insecticidal Plants — Two triterpe acids centoic and centillic acids have been isola from the Ceylon variety of *Hydrocotyle asiati* From the Assam variety also 2 triterpene aci have been separated One of these is close related to but differs from centoic and centell acids it gives a crystalline methyl ester an contains an *a* glycol system The second aci present in the plant occurs in combination with polysaccharide system just as does centellic ac in the Ceylon plant but the identity of the latte has not yet been established A number of wes African plants have been investigated Th alkaloid rhynchophylline has been isolated in sma amounts from the bark of *Mitragyna inermis* A triterpene acid has also been isolated and identified as quinovic acid the acid present in cinchona bark This is of some interest as mitragyna and cinchon belong to the same natural order (*Rubiaceae*) seeking better sources of mitragyna alkaloi *Mitragyna rubrostipulacea* and *Mitragyna cili* have been examined The former proved to be an excellent source of mitraphylline which is apparently the simplest member of the series of mitragyna alkaloids both bark and leaves were found contain about 5 gm per kg of alkaloid Th isolation of rotundifoline from this source is note worthy The only other source of rotundifoline is *M rotundifolia* from which it was isolated together with rhynchophylline

The essential oil from *Brachylaena hutchinsii* has been found to contain 2 dicyclic sesquiterpenes derived from cadalene a sesquiterpene alcohol and a sesquiterpene ketone

Gums — The gum from *Sterculia setigera* has been found to resemble in its properties gum tragacanth and gum karaya It is a partially acetylated polysaccharide and on hydrolysis gives rise to the sugars l rhamnose d galactose d galacturonic acid and d tagatose The presence of the last mentioned sugar is of interest since it is for the first time its occurrence in nature has been reported A preliminary examination of *Khaya senegalensis* has shown it to resemble very closely gum acacia

A relatively rich source of saponin has been found in the wood of *Mora excelsa* which contains up to 10 per cent of the saponin The wood of the related species *M gonggrijpii* also contains a saponin

SOME ASPECTS OF THE FINNISH GLASS INDUSTRY (*Contd from p 27*)

formed by the plunger on the inside so that the finished piece transmits light but no vision

The sealing process as carried out at Karhula is as follows The two halves of the block are lifted from the semi automatic press by a specially designed tool and held in an electric furnace containing molten aluminium They are removed after the aluminium has adhered to the edges placed upon each other and pressed together to complete the seal The block is then annealed The edges are given a water and alkali resistant coating which also assures a permanent bond between glass and mortar

Glass wool is manufactured by the centrifugal process A thin stream of glass at a constant temperature flows from an orifice on to a specially designed refractory disc revolving at a speed of about 4000 r p m The disc accomplishes the centrifugation and the fluid glass is thrown out into thin threads

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for November 1949

ganic Chemicals

888 Catalytic hydrogenation process for the production of hexamethylenediamine *Heating 1 4 dicyanobutene with hydrogen in presence of cobalt hydrogenation catalyst at 75° to* 200 C — I C I Ltd

9958 Leuco sulphuric ester derivatives of vat dyestuffs and intermediates *Treating with a salt of chlorosulphonic acid* — I C I Ltd

9964 New wool dyestuffs of the xanthene series *Sulphonating 3 di 90 or p cyclohexyanilino fluorans* — I C I Ltd

0986 Pyridinium salts and the preparation thereof *Reacting a 3 pyridol with a carboxyl halide and then quaternising the product* — William R Warner & Co

[illegible]1 Preparation of phenols *Heating sulphonic acids with alkaline earth hydroxides to* 350 *to* 450°C *in presence of inert gas and thereafter in the presence of steam* — De Directi Van de Staatsmijnen in Limburg

39028 Production of a pigment from a pigmentry anthraquinone vat dyestuff *Admixing anthraquinone vat dyestuff with aniline and separating the components* Bernier

39847 New vat dyestuffs *Comprises acylating 4 8 diamino 1 arylamino anthraquinone with acylating derivative of anthraquinone 2 carboxylic acid carrying an amino group in 1 position* — I C I Ltd

39965 Wool dyestuffs of the anilinofluoran series *Sulphonating 3 6 di (o or p dialkyl anilino) fluoran containing two sulphonic acid groups per molecule* — I C I Ltd

Drugs & Pharmaceuticals

40638 Process for the preparation of a non aqueous homogeneous therapeutic gel *Aluminium stearate homogeneously dispersed in a non rancid vegetable oil to form a gel for injecting penicillin and its salts* Sharp & Dohme Incorp

41182 Preparation of vitamin B_{12} *Subjecting a liver preparation or streptomyces griseus elaboration product to the action of activated material and recovering the vitamins in purified forms* — Merck & Co Inc

Metals & Metal Products

39203 Alloy steels *Comprising carbon* 05 *to* 6 0 *per cent manganese* 1 *to* 2 0 *per cent silicon* 1 *to* 2 0 *per cent nickel* 0 *to* 40 *per cent chromium* 10 *to* 30 *per cent cobalt* 20 *to* 60 *per cent molybdenum and/or tungsten* 05 *to* 6 *per cent iron* 5 *to* 25 *per cent* William Jessop & Sons Ltd

1639 Decarburization of iron or iron alloy castings *Comprising heating castings to* 850°C *to* 1100°C *in a gas tight furnace circulating gaseous products which is burnt to raise steam in a steam generating unit* — Birlec Ltd

0793 Magnesium base alloys *Consisting of at least* 85 *per cent magnesium* 0 5 *per cent to* 10 *per cent of rare earth metals of which neodymium constitutes at least* 50 *per cent with lanthanum and cerium not exceeding* 25 *per cent separately the balance being one or more of elements proseodymium samarium and rare earth metals* — Magnesium Elektron Ltd

40818 Recovery of zinc from zinciferous material containing iron and apparatus suitable therefor *Heating the molten dross to evaporate zinc and discharging the iron content from the container* — Revere Copper & Brass Incorp

Paper & Allied Products

41365 Process for the preparation of hypochlorite bleaching liquor by the chlorination of a lime containing starting material *Prepared by chlorinating lime containing starting material and the hypochlorous acid so formed is converted to calcium hypochlorite by further adding calculated amount of lime* — India Paper Pulp Co Ltd & Tapadar

Textile & Textile Products

41361 Washing and soaping of printed material *Overflow from the last cistern is fed to the succeeding water cistern and the overflow from the said succeeding is fed to the next and as on whereby a counter current is developed within the cistern* — Datar

39886 Process for colouration of textiles and paper with dyestuffs containing quaternary or ternary salt groups *Printing textile or paper with dyestuff containing quaternary ammonium ternary sulphonium or isothiouronium salt group* — I C I Ltd

41298 Viscose rayon *Extruding in* H_2SO_4 *bath a viscose prepared via alkali cellulose of which the mean degree of polymerization after ripening is greater than* 450 *and a degree of xanthogenation between* 40 *and* 50 — Comptoir Des Textiles Artificiels

Miscellaneous

40348 Improved crucible power press *Comprising a fixed mould and a receptacle swivel joint on a shaft rotating a plunger a clutch on the shaft a protective liner in the mould a ring at the top of the plunger* — Narasimhacharyulu

41421 A process for purifying sugar juice *Juice treated with lime so that alkalinity of the juice is adjusted so that during carbonation colloidal impurities precipitate* — Svenska Sockerfabriks Aktiebolaget

40021 Catalytic desulphurization of naphthas *Passing naphtha in vapour form over catalyst at a suitable temperature and pressure* — Anglo Indian Oil Co

40869 Harvesters of leaf plucking machines for tea leaf *A frame work with another frame-work along with it having adjustable cutting mechanism attached therein* Gordon

India's National Laboratories

TWO events of January 1950 — the opening of the National Chemical Laboratory by Pandit Jawaharlal Nehru, Prime Minister of India, at Poona, and the opening of the National Physical Laboratory by Sardar Vallabhbhai Patel, Deputy Prime Minister, at Delhi — will be chronicled in the history of scientific development in India Both the laboratories, as also the nine others devoted to specialized fields of applied research, owe their inception to the foresight, energy and zeal of Dr S S Bhatnagar who is the author and the architect of the National Laboratories' Network Plan, designed to provide India with research facilities and opportunities such as had not been provided in this ancient land throughout its long history

Planned Research

The two National Laboratories were among the first to claim the attention of Dr S S Bhatnagar It was in September 1941 that, as Director of Scientific & Industrial Research, he put forward proposals to the Government of India for their establishment The story of the translation of these proposals into blueprints and the various stages of the transformation of the latter into magnificent well-equipped laboratories have been reported in this Journal from time to time A survey of the facilities offered by existing research institutions and universities was undertaken soon after the establishment of the Board of Scientific & Industrial Research in 1940, and it was soon realized that, important and useful as such facilities were, the existing institutions were inadequate to meet the growing needs of the country While there was need for continuing support to institutions and university laboratories to enable them to undertake and carry out scientific research on specified problems, there still remained many problems, both in basic and applied sciences, connected with the promotion of national welfare, and demanding attention in specialized laboratories well equipped with refined scientific instruments, where large teams of workers could pursue research and investigation The planning of National Laboratories was actuated by a sense of enlightened realism and takes into account both the needs of industry and the requirements of modern science

Science & Industry should Co-operate

Industrial development in the United States and in the United Kingdom has been largely the result of close co-operation between Government, industry, science and technology Those who speak glibly of increasing India's industrial potential would do well to take this vital fact into account The success which has attended the efforts of the Council of Scientific & Industrial Research in helping Indian industry, during the all-too-brief period of its active functioning, is due to such co-operation which the Council has succeeded in enlisting The Laboratories of the Council at Delhi have served as a testing ground, and the experience so gained has been applied on a large scale in the National Laboratories which hold promise of proving to be effective instruments in the application of scientific knowledge to the practical solution of problems of human welfare

Opportunities for All

The National Laboratories are important from yet another consideration Until recently, science in India had received but little attention and opportunities for young men and women with aptitudes for research were few To quote from the Prime Minister's speech at Poona "Science in the past had certainly not been encouraged, in the sense that neither the man who was able had the chance to do his work properly, nor, even if he did it, had he got encouragement when it was due But in practice, I think I am right in saying that the opportunities have been strictly limited There is talent in our country But the question is how to tap the talent and give opportunities to the young men and women of India, who had the requisite ability Somehow the door seemed to be barred against them, and when it did open, it opened only in a limited way and to a limited number of people So the problem before us, for any kind of progress, is how to tap the vast reservoir of talent and material So if we have the talent in this country and if we have the resources and the material, the problem is how to bring these two together I hope, so far as these laboratories are concerned, they would help to some extent at least in opening the doors to large numbers of young men and women and give them opportunities to do good work for the country in the cause of science and in the application of science for public good"

Promotion of Scientific Spirit

The Government of India, under the leadership of Pandit Jawaharlal Nehru, has shown an enlightened appreciation of the value and benefits of science—an appreciation not confined to immediate results but in the exalted and enduring value of science as reflected in the promotion of objective enquiry, search for truth, respect for facts, faith in reason, and all that is implied by what is called the *scientific spirit* The emphasis which science will receive through the establishment of the National Laboratories will no doubt help in the spread of the scientific spirit throughout the body politic

It is manifest that considered both from the utilitarian point of view or from the long-range influence of science in vitalizing the national outlook, the National Laboratories are destined to have a far-reaching influence Science is no newcomer into this land Science had its early beginnings in India, and it was in India that science flourished unhampered for centuries. Under the stimulus of political independence and under the care of a benign Government, science has once again come into its own The National Laboratories have been planned with care, and considerable thought has been expended in equipping them The services of eminent men of science have been secured to direct their work Established under such good auspices and enjoying the goodwill of scientists and scientific institutions all over the world, the National Laboratories of India have great opportunities and great responsibilities not only in cultivating and applying the knowledge required for India's economic and social advancement, but also of extending the frontiers of science by making distinctive and enduring contributions to human knowledge

The Projected Himalayan Research Institute

S K BANERJI

GREAT importance is attached, nationally as well as internationally, to the establishment of a high altitude research station on the Himalayas The report that India is planning to establish such a station has already excited a good deal of interest and enthusiasm among scientific men all over the world The UNESCO Conference on High Altitude Research held at Interlaken during August-September 1948 adopted the following resolution

> " In consequence of the valuable scientific results that are to be expected from high altitude research and the outstanding possibilities that it offers for international scientific co-operation, all organizations interested in furthering scientific knowledge and in promoting international collaboration should be encouraged to give strong financial support to high altitude research stations "

The following two resolutions were adopted by the Committee on Physical and Astronomical Problems in High Altitudes of the UNESCO

> (i) " That this Committee notes with the greatest interest the Indian proposal to set up a multi-purpose high altitude research station on the Himalayas for study of snow and glaciers, cosmic-ray, radiation, microbiology, Himalayan flora and fauna and for astronomical, meteorological and seismological observations This addition to the net of high altitude stations, in a region where complete facilities have hitherto not been available, promises to be of the first importance "
>
> (ii) " The investigation of cosmic rays, of the ozone layer in the upper atmosphere and of the phenomena of the solar corona are of the utmost interest, the first because of its consequences as regards our basic physical conceptions, the second and third because of their connection with solar activity and its effects upon the earth, particularly as regards climate, weather and radio communications For solution of all these problems, observations at high altitudes are an essential feature
>
> In view of the international character of the value of the results of the investigations and the general benefit to be expected from them, the Committee wishes to emphasize the desirability that high altitude researches concerning these problems should be given financial support from international funds "

The world famous explorer, Sven Hedin, who has contributed so much to our knowledge of the geography and geology of the Himalayas and Tibet, has written welcoming with enthusiasm the proposal to develop a Himalayan Research Institute

Existing High Altitude Stations in the World

Systematic studies on the biological and physical problems encountered at high altitudes were commenced from the latter part of the 19th century At first this was done by sending scientific expeditions to regions of high altitude to study the physiological effects and to make meteorological observations It was Jansen, the famous Director of the French Observatory at Meudon, who established the first high altitude observatory on Mont Blanc This observatory, however, disappeared in the ice Since then, a large number of such stations have been established in Europe, Africa, Asia and the Americas Of these, the well-known Institute Angelo Mosso of Turin University at Monte Rosa, Italy, was established in 1907, the Institute of the Biologia Andiana in Peru in 1930 and the International High Altitude Research Station at Jungfraujoch in 1931 A list of the more important existing stations is given below

	NAME OF STATION	HEIGHT ABOVE SEA LEVEL (ft)	SCOPE OF RESEARCH
1	Pic du Midi	9 494	Physical astronomical and biological
2.	Institute Angelo Mosso Col d'Olen, Italy	9,735	Physical astronomical and biological
3	Institute of Andean Biology, Lima, Peru with laboratory in the city of Hunancayo and another laboratory under construction in *Morococha*	Hunancayo 10 230, Morococha 14 982	Biological
4	Peak of Teneriffe Alta Vista Laboratory, Canary Islands	11 220	Biological
5	Testa Grigia Laboratory, Corvinia Aosta Italy	11,550	Physical
6	International High Altitude Research Station, Jungfraujoch	11 385 and 11 781	Physical astronomical and biological
7	Capanna Margherita, Monte Rosa Italy	15 147	Biological
8	Pikes Peak and Mount Evans, Colorado U S A	15 180	Physical and biological
9	Laboratory of the Aiguille du Midi	?	Physical

At present, the highest research laboratory in the world is the one on the summit of Mt Evans, Colorado, which was established in 1936 This laboratory is currently being used by a number of universities for cosmic-ray research and for biological experiments It is reported that a high altitude research station at a higher level of about 16,000 ft is being planned near Mexico city

Existing Meteorological Observatories on the Himalayas

The India Meteorological Department has been maintaining since many years a number of meteorological observatories at various heights on the Himalayas The highest of these observatories is at Leh, which is 11,529 ft above sea level, almost at the same height as Jungfraujoch The next in order of height is the one at Misgar (10,190 ft) and Dras (10,059 ft) above sea level Others are at heights of 7,500 ft or lower These observatories have given valuable data in determining some of the meteorological features of India, but they are equipped for ordinary meteorological observations only. Their details are given in the following table

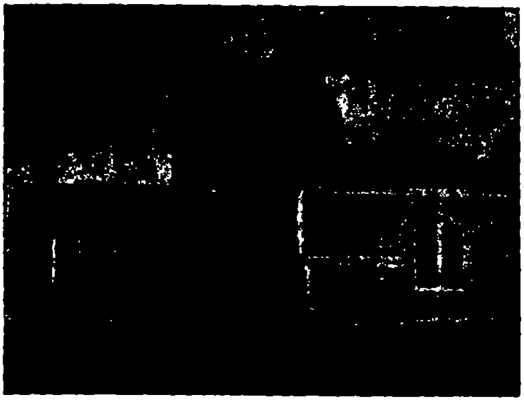
Although in possession of the loftiest mountain system in the world, India has not yet established any research or observation station on the Himalayas, either physical or biological research Recently a few hydrometeorological observatories have been started in higher altitudes, the highest one being one at Lokpal in the Central Himalayas, near Badrinath, at a height of 15,000 ft

NAME OF STATION	HEIGHT ABOVE SEA LEVEL (ft.)	YEAR OF STARTING
Gilgit	4,890	1893
Srinagar	5,205	1891
Skardu	7,505	1896
Dras	10,059	1898
Misgar	10,190	1939
Leh	11,529	1878
Simla	7,224	1873
Mussoree	6,940	1866
Muktesar	7,592	1897
Katmandu	4,388	1879
Darjeeling	7 432	1867
Kalimpong	3,965	1920

The Glory of the Himalayas

From the earliest times, the ancient Aryan pilgrims, being attracted by the glory of the Himalayas, have penetrated deep into the Himalayan gorges and passes The names Kailas, Sindhu, Manasarowar, Kasmira, Gangotri, Badrinath are merged in ancient history Very few of the thousands of explorers have left any written records And today the geography of a large part of the Himalayas is unknown During the last 100 years, survey parties, mainly of the Survey of India and the Geological Survey of India, have made many surveys of this, the loftiest mountain system of the world, and described its essential topographical and geological features Many scientific expeditions have given us valuable knowledge of the Himalayan flora and fauna, existing and fossil Gravity observations on the Himalayas led to the theory of isostacy Expeditions in recent years to the Everest, Kunchanjunga, Kamet, Nanga Parbat and many other lofty peaks, to Karakoram and Tibet, etc, by expert mountaineers and scientists have made additions to our knowledge of a large tract of the Himalayas. Still, immense areas have yet to be explored by modern scientific methods. The aerial photography method adopted by the Survey of India in recent years will be the best method of presenting a pictorial representation of this romantic land

There are many features, particularly the Himalayan glaciology and its rich flora and fauna, which require sustained observation and experimentation, and this can only be done from an established high altitude research station For astronomical observations, for study of cosmic rays and radiation, a research station at an altitude of



Astronomical dome on the top of mountain (16,600 ft) with two ante-chambers for cosmic ray, radiation and solar observations (A 25" Schmidt Cassegrain telescope will be installed)

16,000 to 17,000 ft will provide unique opportunities The high altitude research station, once established, will be the focus from which scientists will move in all directions to seek many new problems and find their solutions

Objects of a High Altitude Research Station

The aim in setting up a research station at high levels is for studying snow and glaciers, cosmic rays, radiation, astronomy, astro-physics, microbiology and high-level meteorology under conditions which do not exist at plain stations All the well-known astronomical observatories of the world are situated on mountain tops because such a position provides many important advantages, the principal amongst these are decrease in the diffusion of light in the atmosphere, decrease in the agitation of telescopic images, and decrease in atmospheric absorption These advantages facilitate the study of numerous astronomical problems which cannot be studied at a station in the plains In physics, high altitude research has centred round two main fields of interest, namely meteorology and cosmic rays A high altitude provides the best location for the study of radiation in all its aspects, including night-sky radiation, for investigation of ozone in the upper atmosphere, both during day and night, and for the observation of special phenomena like mother of pearl clouds, etc The increase of the intensity of the cosmic-ray radiation with height is so great that a few days' work at 3,500 m altitude is equivalent to that of many months' at sea level The study of the effects of high altitude on different aspects of life, the process of acclimatization and adaptation to high altitudes of plants and animals, the changes in their structure and physiology, are some of the important items engaging the attention of modern biologists

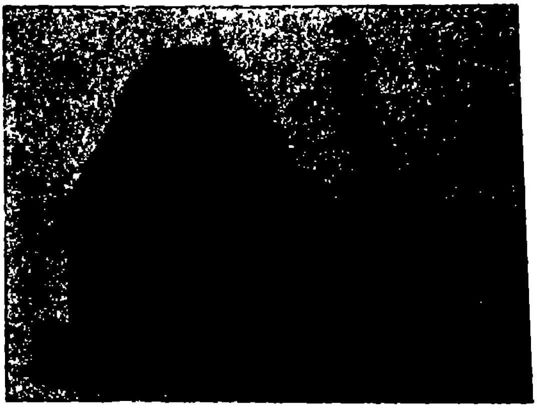
Some of the more important items of research work that can be undertaken at a high altitude research station with special advantage are given below

Physical Science

(1) *Astronomical Problems* — Study of diffused light with a view to catalogue the diffusing particles in the atmosphere Study of atmospheric agitation by (a) evaluation of turbulence by the appearance of the diffraction figure and (b) measurement of agitation by the amplitude of the indentation of a star track Study of transparency and preparation of transparency statistics

Research for which a Low Degree of Diffusion is Necessary —

Study of the sun's corona by means of coronagraph
Location of traces of lunar atmosphere
Research on the Einstein effect
Hagen's research on cosmic nebulae
Cinematography of solar prominences by the use of Lyot's coronagraph and monochromatic filter



General laboratory (physical and biological sciences) and power station on mountain top (rooms to be pressurized)

SCIENTISTS COLONY NEAR LAKE (1) PHYSICAL SCIENCE LABORATORY AND WORKSHOP, (2) BIOLOGICAL SCIENCE LABORATORY (3) (4) (5), (7) & (8) SCIENTISTS' RESIDENCE AND (6) VISITING SCIENTISTS RESIDENCE

Research for which Stability of the Image is Necessary —

- Stereophotogrammetric determination of the configuration of lunar regions viewed tangentially in order to correct the observation of occultations of stars by the moon
- Spectrography of planetary details
- Measurement and spectrography of close pairs of stars
- Determination of trigonometric parallaxes with a far higher degree of precision than at present
- The visual, photographic or spectrographic study of all objects showing minute detail (such as galactic or extra galactic nebulae)

Research for which Transparency is Necessary —

- Spectrophotometry in the ultra-violet
- Location and study of white dwarf stars

(2) *Physical Problems* —

Cosmic Rays — Study of nucleon-nucleus collisions which are observed to optimum efficiency at high altitude stations with a view to study the properties of the unstable fundamental particles of matter

Continuation of the work of Testa Grigia station such as (i) study of the meson decay by different methods, (ii) study of the nuclear evaporation induced by cosmic rays, (iii) study of the positive excess of meson component, and (iv) study of the production of penetrating showers in the interior of Wilson chamber

(3) *Geophysical Problems* —

- The determination of atmospheric ozone by absorption measurements
- Determination of the ultra-violet radiation at the limit of the atmosphere and its relation to solar activity and to special phenomena in the atmosphere
- Molecular diffusion of light in the atmosphere with the elimination of absorption and scattering by dust.
- Measurements of the nocturnal radiation
- Investigation of polar lights, meteors, and the light of the night sky, all phenomena which constitute means of investigating the composition and physical conditions of the highest atmospheric layers
- Study of the aerology of the Central Asian table-land, in particular the influence of the huge Himalayan system on the meteorology of Eurasia
- Study of snow and glaciers (three-dimensional measurements of glaciers, determination of temperature at different depths of the glacier body, evaporation from glacier surface, movement of glaciers, differential movement in the body of glaciers, the melting of glaciers), their contribution to the rivers of India
- Detailed study of the geology and seismicity of the Himalayas

Biological Sciences

Botany —

- Nature of high altitude flora
- Influence of high altitude on metabolism, growth, enzyme activity, etc
- Determination of the upper limit of high altitude flora
- Is high altitude resistance of plants controlled by a genetic factor?
- Influence of cosmic rays on plants, e g. mutation rate
- General ecological problems at high altitudes

Zoology —

- Nature of the high altitude fauna.
- Problems of insect ecology
- High altitude metabolism, growth, enzyme activity, etc

Is high altitude resistance of insects controlled by a genetic factor?

Influence of cosmic rays on insects (e g mutation rate)

General Physiology —

Growth of cell cultures at high altitudes

Influence of cosmic rays on cell cultures (e g on mitosis)

Adaptation and acclimatization of cells to reduced partial pressure of oxygen (respiratory rate, enzymes, etc)

Problems of Human Physiology

Physiology of Climate — Extension of work done at the High Altitude Research Station on Jungfraujoch

Application of methods for testing autonomic reactivity at altitudes of 3,500 m and below

Determination of lower limit where influence of "altitude climate" can be observed

Nature of the influence of altitudes where reduced oxygen pressure cannot be effective factor (below 3,000 m)

Circulation whilst at rest and whilst working

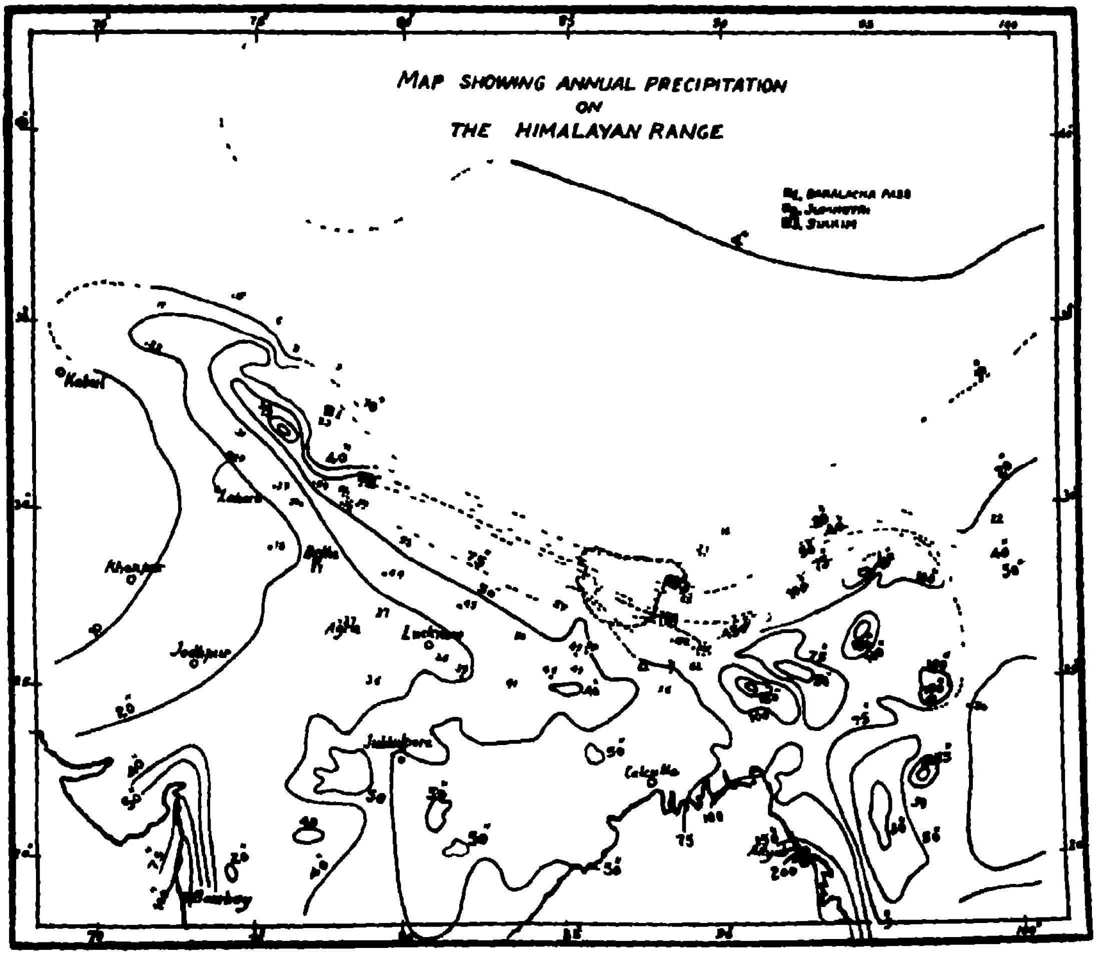
Blood and breathing whilst at rest and whilst working

Functioning of the nervous system

Functioning of the ductless glands and the reproductive organs

Physiology of Adaptation —

Quantitative relations between increased adaptability to lack of oxygen after a stay at high altitudes and length of stay



- Adaptation of high altitude acclimatized men to the low levels

Problems which were suggested by Prof W R Hess, Zürich —

- Studies on sleep (depth and duration)
- Temperature regulation at high altitudes
- Action of high altitudes on autonomic stigmatized subjects
- Fatigue and relation to physical or mental effort
- High altitude and water balance
- Protein metabolism at high altitudes

Physiology of Acclimatization —

- Is the ability to acclimatize controlled by a hereditary factor in the Tibetans, Bhutanese and others?
- Is sterility also found in men brought up since early childhood at high altitudes?

Problems suggested by Prof C Monge, Lima —

- Creation of a special high altitude physiology
- Investigation in physiological-anthropology, dealing with Tibetan populations as a "climative-physiological variety of the human race"
- Studies of adaptation and acclimatization
- High altitude sociology
- High altitude human geography
- High altitude climatology (investigation on climatic factors changing responses to same altitudes in different parts of the world)
- Man and environment ecology
- The problem of coca as botanical and pharmacological problem (i e investigation whether chewing of leaves of *Erythroxylon coca* actually increases the resistance of men to high altitudes)

The Himalayan Institute

With such a multitude of problems to be worked on, and more to be added to them as always happens when an active band of scientific workers are diligently engaged in research, the establishment of a research institute in a suitable location in the midst of the mightiest mountain system of the world must be regarded as one of great national importance as well as world importance

Views have been expressed that the Himalayan flora and fauna differ so widely in the eastern and the western range of the Himalayas that the establishment of a single research institute may not be considered adequate for biological studies. The same views have also been expressed in respect of geophysical studies But considering the time factor and the cost involved in establishing a fully equipped research institute of this kind on high mountain level, the establishment of a single multi-purpose research institute should be the immediate desideratum As work progresses and it becomes fully developed, sub-stations could be established later in other advantageous locations

As, for many of the researches to be undertaken, observations have to be taken at different altitudes, the greatest advantage would be obtained if the living "colony" of scientists be located at an altitude of about 12,000 ft, and the astronomical dome and a general laboratory only at an altitude of about 17,000 ft The location selected should be such that higher altitudes can be reached without difficulty for any special experiments, and that glacier fields are close by for glaciological studies Moreover, the accessibility and the living conditions of the location must be such that the scientists could work comfortably for all the 12 months

The laboratory at 17,000 ft would require to be a pressurized chamber and to be heated electrically The living houses, the library, the laboratory and workshop at 12,000 ft will need to be provided with comfortable heating arrangements For this, ample wind-power is available at high altitudes on the Himalayas for conversion into electricity Waterfalls can also be used for the purpose If hot-springs be available nearby, the same could also be used for heating houses (as is done in Iceland)

Reports so far received indicate that suitable sites satisfying all the above requirements are available in North Sikkim close to Thanggu on the road from Gangtok to Thanggu, in Bara Lacha area in the East Punjab Himalayas close to the road from Minali to Leh and at about 20 miles north of Badrinath in the Central Himalayas on the road from Badrinath to Mana Pass

A point to be kept in mind is that a high altitude station at a height of about 17,000 ft., close to glacier fields, will excite a very great amount of public interest Therefore, the aim should be to develop means of transport (road and air communications) so that the public can reach the height with comfort As in the case of Jungfraujoch, the investment will then be repaid by ample dividends

North Sikkim is on the latitude 28°N, while Bara Lacha is on 32°N The amount of snowfall is very nearly the same in the two areas But on account of the higher snowline in North Sikkim, the roads can be kept clearer for traffic throughout the year than in Bara Lacha Moreover, North Sikkim is described geologically as Jurassic, somewhat Tibetan in characteristics, and its high plateau of 17,000 ft and above has been reported by many explorers to present remarkably clear skies

Location for the High Altitude Research Station

The site for the station, as stated above, should be on a barren mountain top, with a fairly extensive area at a height of about 17,000 ft, where scientists could work comfortably if modern working conditions are made available An area of about 5 acres would be required for locating the main observatory The site should have an unobstructed horizon, specially towards the north and south, and no neighbouring peak or object should subtend an angle of more than 10° There should be easy access to neighbouring glacial fields The locality should be such that various instruments, such as cosmic-ray recording apparatus or radiation instruments, can be carried by mechanical or other means to still greater heights, say 18,000 or 20,000 ft, exposures arranged for limited periods, and brought back to the main laboratory The scientists' residential colony should be located at a height of about 12,000 ft, from where a motorable road should be constructed to the observatory

One of the essential features which the location should satisfy is that the place should be easily accessible from the nearest rail-head or motor-head, and that it should be as near as possible to one or other of the important trade routes across the Himalayas to Tibet or Central Asia

Enquiries made from persons who have travelled extensively in the Himalayas, and a study of the reports on the Himalayas published by explorers and mountaineers show that the regions where suitable sites are likely to be available for setting up the observatory are (i) Bara Lacha Pass, (ii) Jumnotri, (iii) North Sikkim, (iv) Badrinath and (v) Lipu Lekh area (near Manasarowar) After a discussion of the matter with experts it was agreed that the investigation of the Lipu Lekh area should be given up, because this area is not easily accessible It was decided to arrange for tours of scientists to investigate the Badrinath area, North Sikkim, the Jumnotri area and the Bara Lacha Pass in the summers of 1948 and 1949 The reports from these tours which were arranged by the India Meteorological Department and the Central Waterpower, Irrigation & Navigation Commission in connection with their hydrometeorological and snow survey work, and in which the Council of Scientific & Industrial Research and the Geological Survey of India co-operated, indicate that very good sites for a high altitude research station are available in North Sikkim, near Manna Pass, north of Badrinath, and in Bara Lacha area north of Rohtang Pass, on the road from Pathankot to Leh No final decision has yet been reached regarding the site The Council of Scientific & Industrial Research has appointed an Expert Committee to select the site and prepare a detailed plan for the high altitude research station The selection will be made so that it meets the requirements of astronomers, physicists, glaciologists, biologists and meteorologists The accessibility of the site will be an important consideration, so that it can be reached by tourists and international workers without difficulty

Buildings, Power Supply & Equipment

For the Himalayan Research Institute, we will require a band of enthusiastic workers, but that will not be forthcoming all at once The development of the Institute should, therefore, proceed in stages

In the first stage, we should have on the mountain top (at about 17,000 ft) one astronomical dome and two rooms for cosmic-ray, ionospheric and radiation studies, a coronagraph, spectroheliograph and instrument for ozone spectrography There would be a building for general laboratory and power station and an enclosure for meteorological instruments

Lower down in the scientists' colony at about 12,000 ft, we should have

(1) One compact building to accommodate
    (a) Library — one room

(b) General Laboratory — four rooms
  (i) Biological Science,
  (ii) Physical Science,
  (iii) Snow and Glacier,
  (iv) Meteorology
(c) General Stores — one room
(d) Workshop — one room

(2) One Seismograph Building
(3) One out-house, two rooms, for balloons, hydrogen, oil storage, etc
(4) Residential building for six scientists
  (a) One astronomer
  (b) One physicist
  (c) One botanist
  (d) One physiologist
  (e) One meteorologist
  (f) One hydrologist (snow and glacier)
(5) Residential accommodation for twelve scientific assistants (two for each department)
(6) Residential accommodation for four visiting scientists
(7) Residential accommodation for twelve attendants
(8) One special building for storing provisions for the staff

Power Supply — A power station working with windmills will have to be fixed up on the mountain top to work a system of storage batteries with large capacity delivering about 110 volts This will not be difficult as, over the Himalayas at 16,000 ft and above, there is strong westerly wind throughout the year, which can be made to work windmills and so provide power Alternatively, if there is a waterfall near about the site, then this can be used to generate electricity In many places in the Himalayas there are hot-springs, and if one happens to be available near the site selected, it could be used to heat up rooms in the same manner as it is done in Iceland

Equipment — The costliest equipment will be the astronomical telescope Provision was made in the post-war development plan of the Meteorological Department for one large telescope (a 40" refractor or a 100" reflector) costing about Rs 25,00,000 and one medium-size telescope, a 25" Schmidt-Cassegrain telescope, costing about Rs 5,00,000 The present views are that the large telescope should be installed in the Kodaikanal Astronomical Observatory and the 25" Schmidt-Cassegrain in the Himalayan institute

For cosmic-ray work, a counter-controlled Wilson chamber will be required For radiation observations and for meteorological work, the equipment can be made available from the stock of the Meteorological Department Microscopes and other instruments for biological work, equipment for study of snow and glaciers will have to be acquired Miscellaneous laboratory equipment and a few essential workshop equipment will also have to be provided

Transport from Colony to Observatory

A very important consideration in selecting the site for the observatory should be its approach from the colony to the mountain top On this road small cars, or a special type of snow-cat, could work up and down As an alternative arrangement, funicular railways in three or four stages could be progressively developed In any case, the mode of transport from the colony to the observatory must be regarded as a very important item in the scheme as that will contribute to the efficient working of the observatory by minimizing the physical exertion of the scientists who will have to go there day after day from the colony

Road from the Rail-head or Motor Terminus to the Scientists' Colony

The selected site will be situated close to one of the important trade routes, and the development of this road from the nearest rail-head or motor terminus to the scientists' colony will have to be undertaken so as to make it motorable For instance if the site selected is the hill top (16,600 ft) near Thanggu in north Sikkim and the scientists' colony be built close to the Traveller's Bungalow in Thanggu (12,580 ft), the road from Gangtok to Thanggu (62 miles), which is a fairly broad road, will have to be developed and made motorable

Such a development will invite many visitors to the high altitude station, and the revenue that will be derived thereby will provide ample return for the investment made

Storage of Provisions

As the road connection between the scientists' colony and the nearest rail-head or motor terminus may occasionally be cut off by snowfall, it will be necessary to store ample provisions of food, gasoline, etc , for the scientists if they are to work comfortably throughout the year

Provision of all essential medicines will also have to be made As amongst the staff there is provision for a physiologist who will be a medical graduate, no separate medical officer will be necessary to look after the health of the small staff of scientists

Communications

The scientists' colony would require to be provided with a short-wave W/T transmitter and receiver to maintain communication with the nearest W/T station If located in North Sikkim, communications could be maintained with Darjeeling Telephone links will have to be provided between the observatory on the mountain top and the scientists' colony

Cost of the Scheme

The financial aspect of the scheme has not yet been worked out on a firm basis It is not possible to do so before the site is established, and assessment made of the constructional work that will be required On a very rough estimate it is believed that the capital expenditure on buildings and roads, including power installation and radio transmitting station, will be of the order of Rs. 40 lakhs No doubt the capital expenditure will be considerable, but it will be spread over 10 or 15 years Also, this is to be a co-operative scheme , the costs are to be met jointly by all the various Scientific Departments of the Central Government interested in the scheme — the Council of Scientific & Industrial Research, the India Meteorological Department, the Central Waterpower, Irrigation & Navigation Commission, the Physiological Division of the Health Department and the Botanical and Zoological Surveys of India — and, therefore, when so distributed, the effect on their respective budgets will not be very considerable

If we succeed in establishing the station at an altitude of 16,000 or 17,000 ft (the highest now existing is at 15,000 ft), it is sure to be a focus which will attract scientists of international repute from all countries, and will itself be a centre from which scientists will move in all directions to seek the solution to many new problems When fully developed, it is also expected that a station of this nature will attract a large number of tourists, the influx of which would assist the station in meeting a considerable portion of its maintenance expenses

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Characteristics of the Ionosphere over Calcutta (November 1949)

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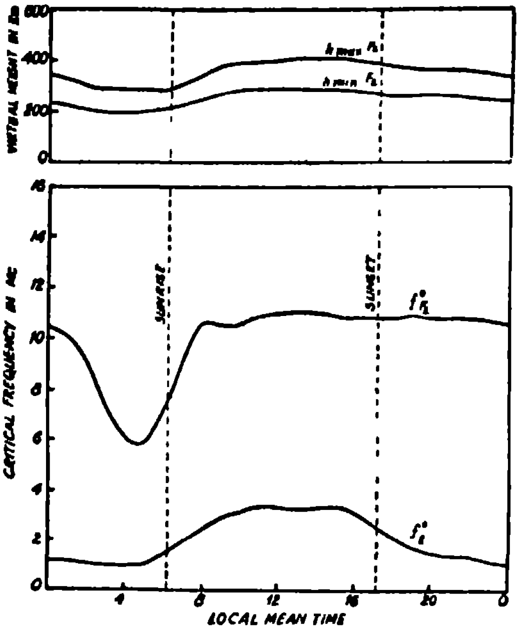
THE following are the ionospheric data observed at Calcutta for the month of November 1949

Fig 1 represents the mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of February 1950 Table I gives the different occasions during routine observation when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights



(5 HR 54 MIN AHEAD OF G M T)
FIG 1 — NOVEMBER 1949

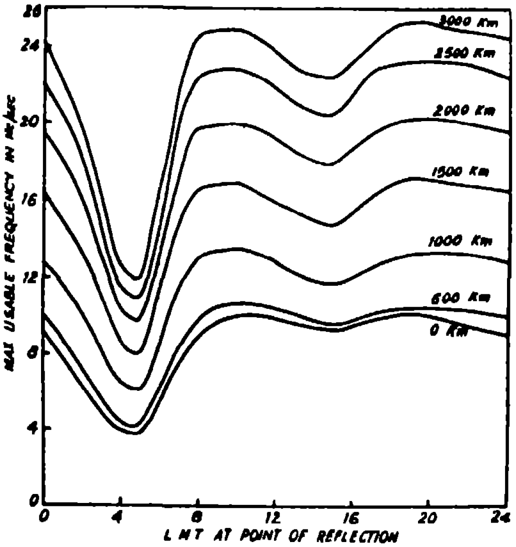


FIG 2 — PREDICTED M U F VIA F_2 LAYER, FEBRUARY 1950

Sporadic E ionization was found to occur less frequently in this month Absorption of normal E echoes at mid-day was also less The behaviour of region F_2 was found to be less normal in this month than in the previous one

TABLE I

MONTH & YEAR	DATE	HOUR	$f^\circ E_s$ Mc	$h E_s$ Km
November 1949	1	18 00	3 55	120
	3	21 00	2 60	105
	4	08 00	3 70	120
		09 00	4 00	120
		14 00	4 20	135
		15 00	4 25	135
		16 00	3 75	120
		17 00	3 20	120
		18 00	2 85	105
		19 00	2 90	90
	5	09 00	4 25	120
		10 00	4 50	120
	7	09 00	4 20	120
		17.00	4 25	120
		18 00	4 25	120
		19 00	4 00	105
		20 00	3 20	105
		21 00	2 75	90
	8	08 00	7 00	135
		18 00	3 20	120
		19 00	2 50	105
		20 00	2 75	105
		21 00	2 75	105
		23 00	2 60	90
	10	15 00	4 80	120
		16 00	4 80	120
		17 00	3 35	105
		18 00	3 30	105
	11	15 00	3 60	120
		17 00	3 75	120
	17	15 00	4 65	120
		16 00	4 10	120
		17 00	3 75	105
		18 00	3 20	105
	18	20 00	3 50	105
	24	17 00	3 20	105
		18 00	2 90	90
	28	17 00	3 20	105
	29	17 00	3 15	105
		18 00	2 90	90

Symposium on Microwaves

A SYMPOSIUM on microwaves was convened by the Radio Research Committee of the *Council of Scientific & Industrial Research* during the last week of December 1949 It was inaugurated by Dr S S Bhatnagar and conducted under the chairmanship of Prof M N Saha in the premises of the Meteorological Department The four-day programme was divided between reading of scientific papers, of which there were 26, an indoor exhibition of instruments such as the frequency modulation transmitter and instruments employed in meteorological studies and outdoor demonstrations of radar and other working units A number of Government Departments including the Meteorological Offices at New Delhi and Poona, the Defence Department, the All India Radio, Department of Civil Aviation, the Technical Development Establishment (O & E), Dehra Dun, and the Central Electricity Commission, Simla, Universities of Banaras, Delhi and Calcutta, the Bengal Engineering College, and the Banaras Hindu University Engineering College, the National Physical Laboratory and the Royal Institute of Science, Bombay, contributed papers in the fields they are interested in Members of staff from many of these institutions took part in the reading and discussion of the papers

Inaugurating the symposium, Dr S S Bhatnagar hoped that the papers presented at the symposium would further our knowledge on the subject of microwaves He said that as a result of the impetus given by this symposium, the *Council of Scientific & Industrial Research* might consider the possibility of extending its activities in this field a little more He informed the scientists assembled that the *Council of Scientific & Industrial Research* contemplates the establishment of an independent field station at Calcutta for carrying out researches on radar, ultra-short and microwaves

Prof M N Saha, in his presidential address, referred to the amazing advances made during the war in America and Europe on ultra-short and microwaves To study the voluminous literature, to find out the basic advance in theory and technique and to sort out their applications to various fields cannot be a single man's job Hence the Radio Research Committee of the Council formed a number of study groups on different branches of this subject The result of these studies were presented by leaders of these study groups at the symposium in the form of papers and were discussed along with individual suggestions for the initiation of techniques and of research in their individual lines He pointed out that the symposium was not an end in itself It was only a ground-work for embarking on a programme of research on ultra-short and microwaves throughout the country

The volume of information released at the end of the World War II revealed the phenomenal advances that had been made in the technique of microwaves and the precision with which it can be applied for the location of targets Whatever might have been the usefulness of the technique — and it has been great — in warfare, it is abundantly clear from the discussions that followed that it will have much wider application for peace-time studies of various natural phenomena

We are, however, new to the modern advances and techniques in the field of microwaves and their applications with the exception of the pioneer work of Sir J C Bose in this field This is the first occasion when Indian scientists met in conference to review the modern advances in this highly specialized subject It can be said that the only achievement so far made is to set a few radar units going in this country But this in itself is no small achievement , the men who did it had no previous knowledge of the technique The only apparatus they had was a few obsolete parts of radar units acquired from war disposals It was indeed encouraging to listen to Dr L S Mathur of the Meteorological Department say that they knew all about the radar units in their possession, and that we have now in this country a number of installations put into working order and working efficiently The units in our possession are no doubt old and a great deal of improvement must have been made in newer models but as an exercise in the use of the technique, the equipment on hand certainly offers a big opportunity

That highly skilled technicians are required for the successful operation of these units was evident from the talk of the R I A F. representative who from his own experience found that it was a highly specialized and intricate job to work the equipment consistently and accurately for long and that the faults kept on cropping up This shows that the necessary skill for the manipulation and upkeep of the installations is wanting and that highly trained operators alone can run the equipment and obtain results on which any reliance can be placed

The India Meteorological Department have been quick to seize the opportunity and are now supplementing their observations with the radio sonde by the microwave investigation of the phenomena of wind and weather. Dr S S Banerji, Director, Meteorological Survey of India, enumerated the phenomena that could be investigated with the help of the new technique, provided, of course, equipment of suitable range and power was available The interests of the Civil Aviation Department are identical The Defence Department, besides making use of microwave technique in the study of weather, are also interested in the navigation of aircraft and location of targets and will have to train their own personnel for the job

Besides these a comprehensive survey of various other applications of the microwave technique was presented during the symposium in a number of papers Prof M N Saha summarized the application of the microwave technique to the study of nuclear properties of matter and microwave spectrometry and pointed out that innumerable studies of the properties of matter can be made at microwave frequencies

No original papers could be expected at this stage, and whatever papers had been presented were in the nature of a survey. They were really valuable in that they constituted an effort to bring us in line with the recent developments in the field and the laboratory Some papers from the Meteorological Department contained their own observations obtained during routine studies

Besides these applications of the technique, microwaves themselves are a subject of study The generation, propagation, reflection and refraction of microwaves open up a vast field and the progress of the technique no doubt will ultimately depend upon our understanding of the properties of these waves

Trained personnel will ultimately determine the extent to which useful application of the technique can be made and the precision with which observations can be obtained. No institution today exists in this country where such training could be obtained and assistance of other countries in this respect may be necessary

Whereas departments like Meteorological Survey, Civil Aviation and Defence will ever be interested in the applications of this technique, it must be the duty of universities and other institutions like the National Physical Laboratory to undertake work on the study of microwaves themselves It is these institutions which must ultimately provide trained personnel to the Departments which want to apply this technique to a study of their problems

Whatever be the present state of affairs as regards equipment and trained personnel, a start had to be made somewhere and the present symposium is a beginning It was an absolute necessity to give the workers in the field an impetus and to co-ordinate the activities of different workers and organizations This the present symposium has achieved with a conspicuous measure of success

A S B

Microbiological Assays

UNDER the auspices of the National Collection of Type Cultures, India, and the Society of Fermentation Technologists, a symposium on the Microbiological Assay of Amino Acids, Vitamins and Other Growth Factors was held during December 1949 The Indian Dairy Research Institute and the Fermentation Technology Section of the Indian Institute of Science participated in the symposium 12 papers dealing mainly with the techniques developed in these laboratories were presented

The isolation, characterization and maintenance of lactic bacteria from various sources were discussed A paper from the Indian Dairy Research Institute referred to a few new isolations of lactic acid bacteria and indicated their use in microbiological assays

The handling and the preparation of test organisms for purposes of assay were discussed in a paper wherein it was pointed out that the methods employed must secure for the organisms stability, reproducibility and sensitivity of performance The effect of repeated transfers and prolonged storage, rejuvenation of attenuated cultures by passage through enrichment media were also discussed in detail

The choice of micro-organisms for the assay of amino acids and vitamins was the subject of another paper The conditions which determine the choice of a micro-organism for a given assay include the degree of response of the organism to minute dosages of the factor by way of growth or acid formation This response should ordinarily correspond to that attainable in a natural medium, (2) in the absence of the factor, however, the growth should be negligibly small, (3) the response to graded dosages (within a reasonably large range) should show linearity, and (4) repeated assays of the material should check within 5 per cent The results of studies on the vitaminic requirements of 28 strains and the amino acid requirements of 21 strains of the lactic acid bacteria were presented

The importance of the preparation or pretreatment of samples for microbiological assay was emphasized For a quantitative estimation of the total content of amino acids and vitamins, they have to be released from this " bound " condition The relative merits of hydrolysing agents, acids, alkalies and enzymes usually employed for this purpose were discussed

Analytical methods generally employed in microbiological assays are essentially based on measuring some type of metabolic activity, for the promotion of which a given constituent is indispensable The type of activity chosen for measurement is influenced by (a) the rapidity, range, linearity and sensitivity of response, (b) reproducibility, and (c) simplicity and ease of measurement The efficiency and accuracy of methods, photometric, titrimetric, fluorometric, conductometric and dilatometric, were critically appraised

The application of partition chromatography in the qualitative analysis of protein hydrolysates for establishing their freedom from one or a group of amino acids was described in a very interesting paper Microbiological assay would offer an ideal procedure but the method is time-consuming and cumbersome The two-dimensional paper chromatography, coming to be known as *papyrography*, makes it possible to partition the amino acids and detect them in microgram quantities In specificity and sensitivity, this method is shown to compare favourably with microbiological assays A *papyrographical* analysis of casein hydrolysates, normal and treated, the prolamine from ragi and fibrin from blood, has been carried out

The possibility of employing protein hydrolysates in which certain amino acids can be selectively and quantitatively removed or destroyed in microbiological assays was discussed Treated casein hydrolysates have been extensively used for routine assays of tryptophane, methionine, arginine and cystine Such hydrolysates provide a simple, inexpensive and well-balanced mixture which can replace the usual medium compounded from individual amino acids

The occurrence of a new growth-promoting factor in acid hydrolysate of papain and in lac residues has been revealed by using *L arabinosus* NCTC-2161 as the test organism Liver extracts have been shown to contain some more factors which are active for *L citrovorum* Another review described the microbiological assay of amino acids in proteins and tissue fluids with particular reference to the amino-acid requirement of lactic acid bacteria The paper entitled "Determination of Vitamins in Biological Materials" discussed the estimation of the overall vitaminic potency of extracts of fish and sheep livers, liver residues, *Neera*, *toddy* and *mahua* flowers, employing yeasts and lactobacilli

The determination of trace elements and other growth factors employing micro-organisms was described in yet another paper The response of *A niger* to trace elements, the specificity of *Pneumococcus* and that of *Haemophilus influenzae* to chloine and to co-enzymes I and II, and the response of a large number of lactic organisms and *Clostridia* to purines and pyrimidines were discussed The methods available for microbiological determination of co-enzyme by *H parainfluenzae* and of a few of the trace elements (Mo, Cu, Mn, Zn, K, P) by *A niger* were described

Effect of Manganese on Steel: Literature Report No. 3

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THE introduction and development of alloy steels resulted from an endeavour to improve ordinary carbon steel to produce material having comparable strength and hardness, together with ductility, toughness, shock and impact resistance and good fatigue values Recent developments include the wider application of alloy steels for constructional and engineering purposes, production of heat-resisting steels and alloys, and the superhardening of steel and its application in general engineering In this paper the results obtained by various investigators on the effect of addition of manganese on the properties of steel have been reviewed

Investigations on the effects of manganese additions to steel have proved that the various physical and chemical properties of structural steels are improved to varying degrees Tensile properties, resilience, formation of austenite in high-speed steels, brittleness, micro-structure, heat and corrosion resistance are some of the properties which are favourably altered by manganese addition

Geisen[1] found that pearlitic manganese steels (0 7 per cent Mn and 0 3 per cent C or 0 5 per cent Mn and 0 95 per cent C) have about the same brittleness as ordinary carbon steels A steel with 5 5 to 11 per cent manganese is more brittle and harder than that in which the manganese content is higher or lower Generally, the hardness and brittleness of high manganese steels are increased by quenching The values of these properties are, however, diminished by quenching low carbon steels with a manganese percentage of 19 5 per cent and in the case of high carbon steels when manganese content reaches 7 5 per cent

According to Thum[2], brittleness in steels having a manganese content above 1 per cent can be overcome by reducing the percentage of carbon The brittleness is not due to manganese alone, but due to the combination of manganese and carbon He cites the instance of rails to prove the point that Bessemer steel for railroads is generally recarburized with spiegeleisen or a mixture of spiegeleisen and low phosphorus pig iron

Before the first World War, structural steels were alloyed in the as-rolled condition to obtain extra strength Later on, possibilities of heat-treated carbon steels and low alloys of manganese were investigated The low alloy steels were found to have fairly enhanced physical properties compared with carbon steel

During the war, the Washington Naval Conference put a limit on the weight of warships, steels with uniformly high proportional limits were, therefore, in demand Ship-designing had formerly been based on the assumption that the proportional limit of ship plate and shapes is one-half the tensile strength, precise tests showed that this factor varies widely, the average being 18,000 lb /sq in Stresses in a ship's hull could be determined accurately, and these stresses should not cause permanent set in the frames Therefore, using a steel of uniformly high proportional limit, the actual limit of elasticity could be used for design purposes and much weight saved This improvement could be made by heat treatment of higher carbon steels and mild structural steels, in the form of Martinel Its average elastic limit was 37,000 lb /sq in as compared to the value 19,000 lb /sq in for ordinary mild steel A saving of 10 to 14 per cent in dead weight was possible on several ships, when the material used in the stress-carrying portion of the ship was heat treated

Medium manganese steels in the as-rolled condition possessed even better properties than heat-treated carbon steels Such a steel (" D-quality " steel) contained about 0 33 per cent carbon, 0 12 per cent silicon and 1 1 to 1 4 per cent manganese and had a minimum proportional limit of 38,000 lb / sq in Improvement of strength properties by increasing manganese content was possible Also, age-hardening effects of manganese were not a source of trouble so long as manganese was less than 1 8 per cent in a 0 20 per cent carbon steel or less than 1 4 per cent in a 0·35 per cent carbon steel

Thomas[3] refutes the theory that manganese is an embrittling factor in steels for hardening The generalization should be considered in a broader sense, as the carbon content also is a major factor A 0 30 per cent carbon steel could carry up to 1 4 per cent manganese with perfect safety, but if, the carbon content were increased to 0 50 per cent keeping the manganese content unaltered, the steel would become too brittle for hardened work Steels of hardening quality have a narrow range of suitable manganese percentages, which give satisfactory results during and after heat-treatment stages Comparison of physical properties of two medium carbon steels, one having 0 67 per cent manganese and the other 0 81 per cent manganese, revealed that the higher manganese variety possesses greater hardness, strength and resilience It was computed that a 14 per cent increase of manganese in a 0 53 per cent carbon steel improved the hardening capacity of the material, and caused an increase in strength and resilience by 52 per cent and 63 7 per cent respectively

According to Neville and Caine[4], the effect of manganese on carbon steel is interdependent and the presence of carbon augments the influence of manganese and vice versa The ultimate strength of the alloys was found to increase by a value varying between 90 and 250 lb /sq in for each addition of 0 01 per cent of manganese, lower rates of increase are suitable for alloys of low carbon content The proportional limit was found to be affected in much the same way as the ultimate tensile strength by variations in the manganese content, whereas the ductility was only slightly affected The average increase in Brinell-hardness number for each 0 10 per cent addition of manganese was 0 5, though for low carbon alloys it was somewhat lower

Zuege[5] has shown that cast steel containing 0 27 to 0 37 per cent carbon, with 0 35 to 1 55 per cent manganese, possesses high toughness as well as ductility The additional fact that these are used extensively is further evidence that they give excellent service Besides, their cost is considerably lower, and these steels, after heat treatment, exhibit properties which closely approach those of more expensive alloy steels

Stoughton and Harvey[6] investigated about 50 binary and ternary alloy steels whose chemical analyses and mechanical properties were known The steels have been graded in order of their relative merits and according to the values of strength multiplied by izod impact value " Quality factors " for a large number of alloys whose chemical analyses were known have been calculated.

Elncke[7] investigated the effects of nickel and manganese as promoters of austenite formation in high-speed steels It was found that as the nickel or manganese content in steel increased, the quenched hardness of the high-speed steel fell in consequence of austenite formation It was shown that at higher temperature ranges, such steels had a higher tensile strength and hardness than the unalloyed high-speed steels

Rolfe[8] suggests that steels containing up to 2 per cent manganese are superior to ordinary carbon steel, especially when heat treated Its advantages are increased pearlite formation, higher Brinell hardness and tensile strength and little falling off in ductility The pearlite grain size is finer and there is a definite decrease in the grain size of normalized specimens, although there is not great difference in the structure of annealed specimens with a given carbon content and with high and low manganese content respectively One of the disadvantages is that such steels show temper brittleness with a marked drop in impact resistance at slow rates of cooling after tempering

Kluke[9] found that tensile properties of steel at room temperature and at elevated temperatures show a definite improvement by manganese additions up to 13 per cent Examination of the micro-structures of 30 per cent chromium alloys containing more than 10 per cent manganese with 1 per cent carbon and more than 15 per cent manganese with 0 35 per cent carbon revealed that the occurrence and appearance of FeCr was not much affected by annealing for 100 hr at 600° to 1,000°C

Portevin[10] investigated the variation in the results of shearing tests in relation to the percentage of manganese in steels containing, on an average, 0 8 per cent carbon, manganese ranging between 0 5 and 12 per cent When the percentage of manganese increases from 0 5 to 5 per cent, the resistance to shear R$_c$ and the elastic limit E$_c$ increase till they attain very high values ($R_c = 61$ kg and $E_c = 46$ kg) When manganese content is above 5 per cent, the resistance to R$_c$ shear remains constant at about 50 kg and the elastic limit is also low (between 10 and 20 kg)

Howe[11] states that the effect of manganese on mechanical properties of steel is due primarily to its retarding action on the transformations and on the coalescence of the micro-constituents into progressively coarser masses The retarding effect on the structural changes shows itself in the following ways leading to the formation of finer structure in carbon steels, finer ferrite masses, finer network structure and finer pearlite, and often the replacement of lamellar pearlite with sorbite This greater fineness leads to better quality in general and to a higher elastic limit in particular, though with a corresponding lowering in ductility

Rawdon and Sillers[12] found that manganese, when added to annealed alloys, gives the pearlite a sorbitic structure, even after slow cooling The Brinell hardness of the alloy is increased along with the change in structure

Foulton[13] established that manganese increases the strength of steel directly by combining with carbon, forming Mn$_3$C An indirect beneficial effect of manganese is the removal of sulphur as manganese sulphide It was found that manganese lowers the transformation temperatures The Ac$_1$ point is brought down by 11°F for every per cent increase, the Ac$_3$ point is lowered by 116°F. for every per cent increase in manganese up to 1 per cent but only 6° to 11°F for every per cent increase after 3 per cent, the Ar$_3$ point is lowered by 125°F. for every per cent increase and the Ar$_1$ point is affected differently, the lowering being about 90°F for every per cent increase

According to Larsen[14], manganese in steel tends to enlarge the temperature range of stability of γ iron or austenite Between 1,100° and 1,200°C, manganese atoms can diffuse through the iron space lattice, and one hour's heating at 1,300°C removes the dendritic seggregation by diffusion of manganese atoms to a uniform concentration throughout the space lattice

Barr and Tipper[15] determined the range of transition from tough to brittle fracture of mild-steel plates of different carbon and manganese contents They concluded that the effects of plate thickness and slow rates of cooling in raising the transition range results in the formation of steel plates of higher manganese content

Hiemke and Schulte[16] determined notch toughness of common plate stock as used in the manufacture of pressure vessels over the range 100° to −50°C It was observed that normalizing coarsens the grains of manganese steels, a ferrite network structure being formed. The manganese steel was found to be tougher than the carbon steel under all conditions.

According to Rowe[17], raising the manganese content of a steel (from the usual 0 50 to 0 80 per cent) to ranges between 1 20 and 1 40 per cent plus the addition of 0 2 to 0 4 per cent molybdenum enhances shock resistance   A 14 per cent manganese steel has better abrasion resistance

The *American Manganese Steel Co*, Chicago[18], investigated the phenomenon associated with manganese steel which, under cold working service conditions, develops an increasing surface hardness, going as high as 550 Brinell   A large number of alloy steels were compared, and it was found that the property of manganese steel was unique   Manganese steel castings, compared with other alloy steel castings, give a lower tensile strength but higher abrasion factor, and a higher percentage of elongation and work factor when the surface hardness of both materials was held identical   When the tensile strength was identical, manganese steel showed a greater abrasion factor, elongation and higher surface hardness and work factor, when the abrasion factor was the same, manganese steel showed a much lower tensile strength, a slightly lower surface hardness and much larger elongation and work factor.

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Ciphering of Organic Compounds

The Commission on Codification, Ciphering and Punched-card Techniques of the International Union of Pure and Applied Chemistry at its Amsterdam meeting in September 1949 formulated the following list of requirements for a suitable system for ciphering structural formulae   1 Simplicity of usage   2 Ease of printing and typewriting   3 Conciseness   4 Recognizability   5 Ability to generate a unique organic chemical nomenclature   6 Compatibility with accepted practices of inorganic chemical notation   7 Uniqueness   8 Generation of an unambiguous and useful enumeration pattern   9 Ease of manipulation by machine methods, e g   punched cards   10 Exhibition of associations (descriptiveness)   11 Ability to deal with partial indeterminants

At present, four systems, some of them in incompletely developed form, have come to the attention of the members of the Commission   All persons who may have developed systems are invited to submit them to the Commission   In order to facilitate full consideration by the Commission before the New York meeting of the International Union of Pure and Applied Chemistry in 1951, it is requested that a detailed description of each system be sent before March 1, 1950, to the Commission's Acting Secretary, Prof J W Perry, Room 20-E-215, Massachusetts Institute of Technology, Cambridge 39, Mass., U S A

REVIEWS

The Terpenes, Vol II, Second Edition, by Sir John Simonsen (University Press, Cambridge), pp xii + 619 Price 35s

THE AUTHOR IS WELL KNOWN FOR HIS RESEARCHES on terpenes and their derivatives With his unique studies and experiences, he has collected and arranged all important results on these subjects As an experienced professor, he has made some of the chapters admirably suitable for advanced students, who will be, as a rule, benefited by closely following relevant details with abundant references

Besides the two prefaces and the introduction, the book contains thujane (55 pages), carane (39 pages), pinane (143 pages), santene (28 pages), camphane (254 pages), fenchane (53 pages), index of authors, and index of subjects

Adequate discussions on inter-conversion of enantiomorphs in camphor series with special reference to researches of Namethkin, Waagner and Meerwein have made the publication indispensable as a reference book to all chemical research laboratories Lucid style of writing has made the publication very attractive to read

From a life-long and so successful an investigator, a clear-cut definition of acyclic, monocyclic and polycyclic terpenes would have given relief to many readers Reasonable details of application of present conception of valancy in the formation of these carbon compounds might also be welcome topics for inclusion Recent works on intra- and inter-atomic experiments and interpretations by physicists and physical chemists need not dislocate old established conceptions of inter-atomic bindings in complex carbon compounds like terpenes and their derivatives

J N R

The Chemistry of Perfumery Materials, by R W Moncrieff (United Trade Press Ltd , London), pp 344 Price 30s

FROM " KNOWN TO THE UNKNOWN " IS THE quest of science The only proper and rational way in which man can use his " God-given gift " of intelligence is to seek after truth So long as this pure motive exists and persists, every scientist is great and his work is intrinsically contributory to the progress of mankind However commonplace, however lacking in any of the qualities of genius — whatever may be the immediate or material benefits that humanity derives — it is possible to think and realize that every scientist co-operates with the divine mission of evolution to develop from a lower to a higher state of existence The only qualification that may be insisted upon is that the worker should be sincere, earnest and selfless Thus only he derives strength of purpose even from his own work

The above thoughts occur to the reviewer when he goes through *The Chemistry of Perfumery Materials* This title of the book itself does not do complete justice to the contents of the book which are comprehensive and thought-provoking beyond the known facts of chemistry associated with the perfumery materials Olfactory science and research lead one to the domains of chemistry, physics, physiology and psychology Therefore, the title " The Chemistry of Perfumery Materials " is an under-statement

The author says

" Understanding of the phenomena associated with olfaction is very incomplete The subject lags behind sister sciences Only in a few cases has even partial success resulted from efforts to co-ordinate conclusions from different lines of attack If the subject is treated scientifically and if it attracts the attention it deserves, there is every reason to expect that our knowledge will increase rapidly and that some of the fundamental problems of olfaction will yield their solutions The sense of smell is not so essential in civilized life as it must have been when man was hunter and had to search for food and mate and indeed today this sense is largely atrophied in many of us There are some who go through life with their sense of smell impaired or deficient and yet hardly aware of the fact Probably for this reason the subject has been greatly neglected Academically, the investigation of olfaction should be as interesting as that of vision and might quite easily yield information of practical value It is often the case that a research undertaken purely from academical considerations bears an unexpected harvest of practical value In the case of olfaction the writer is of the opinion that it may be connected with cancer, or at least that there are striking analogies between carcinogens and odorants " (CHAPTER 1, PART II)

This extract, I feel, will explain the aims and objects of the book under review

The contents of the book consist of three parts Part I " Perfumery Synthetics ", Part II " Olfactory Research " and Part III " Essays on Olfaction "

Part I deals with the chemistry of synthetic aromatic compounds, their occurrence, identification and preparation Even though the compounds have been systematically dealt with under several different groups like hydrocarbons, alcohols, phenols, ketones, ethers, lactones, etc , etc , the book does not constitute a catalogue of organic compounds nor a dictionary It is something midway The whole idea seems to be that " science " plus " nose " equals a good perfume Theories on odours are interspersed while describing particular compounds At the same time, practical applications of these various theories are cited in a manner to stimulate interest and further enquiry While eminently useful and helpful to an advanced student of organic chemistry and a practical perfumer, the beginner will find it a little difficult to grasp the purport of the coordinated knowledge easily and, perforce, will have to plod through the book In other words, Mr Moncrieff takes it for granted that the ordinary basic knowledge of organic chemistry is possessed by the reader Very often, suddenly and unexpectedly, details of certain important compounds and their applications are described One, however, notices that there is an obsession in the background about the relationship of chemical constitution and odour

Says the author

" It may not have occurred to the reader that he or she possesses a most powerful and delicate instrument for the detection of chemicals This instrument is the nose, or more properly, its olfactory regions and connections to it "

The first part of the book tries to establish a connection between the chemical constituents of odorous substances and their corresponding reactions or effects on the nose It is not easy to single out the different chapters for any special notice However, the portion on " Alcohol as a diluent " for perfumes has been well done The elaborate chapters on " Ketones " and " Lactones " are in tune with the importance of these types of compounds in perfumery and the phenomenal researches on the subject in recent times The last chapter in part I, chapter 13, happens to be a readable and useful summary of the guiding principles in the art of perfumery A thorough grasp and understanding of part I will prepare the reader for a full appreciation of parts II and III, which, according to the moods and inclinations of the reader, may be described as the romance of perfumery, or the philosophy of perfumes, or the fundamental biological aspects and functions of odours or perfumes in nature and in society, with suggestions for new fields of adventurous research A good portion of theories on olfaction which had been dealt with in an earlier book by the same author (*Chemical Senses*, published by Leonard Hill Ltd , London, 1944) has been summarized and reproduced in different sections of parts II and III There is an intriguing array of subjects in the forms of more or less self-contained essays Look at the choice fare spread before you for your selection

(a) The Message to the Brain
(b) The Number of Fundamental Odours
(c) The Stimulus, Wave or Particle?
(d) Odour and Molecular Architecture
(e) Is there any relation between Odorants and Carcinogens?
(f) Can smell be detected other than by nose?
(g) A new animal fixative may appear
(h) Musings on Olfaction
(i) The Aphrodisiac Basis of Perfumes, etc , etc

A plea has been put forward in the last chapter for the creation of a ministry for olfactory research This is certainly out of place in this book

In these days of marvellous advances in science, we already hear of tabloid food preparations containing a guaranteed number of calories, reinforced with proper doses of vitamins Progress in synthetic aromatic chemistry has already placed within our reach the rose perfume without roses, and cabbage flavour without cabbages and recently an advertisement in the American Press publicized a "Steak and Onion Odour" which, when added to some artificial food preparations, will make the hungry mouth water in an appetizing way, thus eliminating a visit to the butcher's shop for the juicy steak or to the vegetable shop for the purchase of spring onions Not being satisfied with a mere imitation of a natural odour or flavour, Mr R W Moncrieff in a whimsical and dreamy way makes a prediction He states as follows

"I think that, at present, it is beyond the limits of human ability to imagine a sensation that has never been experienced, although there may be no reason, when the human brain has undergone further development, why in some future age, sensations hitherto unknown should not be experienced Perhaps this would be a certainty, were it not for the decrease in fecundity which normally accompanies increased intellectual capacity — the FISHER-EFFECT Even here, however, there is every hope that our geneticists may over-bridge the problems involved"

Let the reader decide whether we should dread a new stink or welcome a new perfume !

An aspect of modern researches in synthetic aromatic chemicals of particular importance to India should be mentioned In the previous paragraph it has been stated that it is now commonplace to have a rose perfume without a rose or a violet perfume without violets News comes through an American journal that during war time researches in Germany have revealed that it is possible to reproduce synthetically the true and faithful odour of the East Indian sandalwood By the acidic condensation of cuminaldehyde with methyl ethyl ketone (in the presence of boron trifluoride) there results an unsaturated ketone When this is completely hydrogenated, one gets 2-hydroxy-3-methyl-4-(4-isopropyl-cyclohexyl)-butane Upon dehydrogenating this alcohol, the ketone that is formed has the odour of the East Indian sandalwood (*American Perfumer*, May 1947)

India had a monopoly in natural indigo Synethetic indigo replaced it Another monopoly of India, viz shellac, is being threatened by synthetic resins Active research is afoot in the field of synthetic fibres to replace jute East Indian sandalwood happens to be the monopoly of India and more specially of the State of Mysore A dozen years ago or so, sulphonilamide group of drugs replaced sandalwood oil for therapeutic purposes Now comes the news of a synthetic organic compound faithfully reproducing the odour of the East Indian sandalwood This is something for the Government of Mysore to think about !

In conclusion it may be stated that it is quite possible for a very strict, austere and impatient critic to get irritated by parts II and III of this book It is also easy to pick out some omissions It is all a matter of one's own outlook when a reader takes up a new publication for study There is no need to chastise or chide Mr Moncrieff as one or two critics have already done I welcome the book — all the three parts of it !

S G SASTRY

Statistical Methods in Research and Production, with Special Reference to the Chemical Industry, edited by Owen L Davis (published for the Imperial Chemical Industries Ltd, by Oliver & Boyd, London & Edinburgh), Second Edition, 1949 Price 28s net

REFERENCE MAY BE MADE TO THIS JOURNAL, Vol VII, No 9, September 1948, pages 413-15, where (the first edition of) this book has been reviewed by the same reviewer The second edition differs from the first only in some minor respects, and these have been listed by the author himself as follows correction of printing errors, occasional improvements in writing, additions to the list of references, rewriting paras 4 5, 4 51, 8 61, and Appendix 5L, the only new insertion being Appendix 4F

It would, therefore, have been sufficient, normally, to state the above and to stress that the fact that a second edition has been called for after such a short interval is proof of the popularity, or usefulness, of the book

But judging from a paper which the editor of this book, Owen L Davis, gave under the title "Biometric Methods in Chemical Industry", at the Geneva meeting, August 1949, of the International Biometric Society which this reviewer attended, it would appear that Dr Davis and the Imperial Chemical Industries Limited, Dyestuffs Division, are going full speed with the application, and development, of statistical methods and, therefore, it would not be surprising if a third edition incorporating these appears before long

It is to be realized that a substantial portion of the activities of the chemical industry is taken up in testing methods in process development at the laboratory, or semi-technical, or mass-production stage The tests relate to changes in reaction conditions on the yield and quality of a chemical product and the designs of investigation vary, of course, depending on the testing methods, testing equipment, main sources of error, etc Generally speaking, the factorial designs with their many aspects are proving of great value here too, as they certainly did in agricultural work, although of course, in industrial experiments, the time scale is shorter than the season or the year, and the sequential nature is greatly emphasized Moreover, the range of variables examined and the magnitude of high order interactions tend to be larger in chemical and biological work besides the ever-present ticklish problem of determining in advance the size, or the number, of experiments It is fortunate, however, that by suitably confounding, or partial factoring, the designs, the excess number of experiments can be utilized for study of other interactions or other levels A good many such designs have now been brought to light, and not a few by an Indian statistician, Dr C R Rao, to whose research Dr Davis gave a graceful reference in his own paper at the Geneva Biometric Conference

K B MADHAVA

Soils and Some Related Agricultural Aspects of Mid Hawke's Bay — Bulletin No 94 (Department of Scientific & Industrial Research, New Zealand), 1947, pp 176 Price 5s

ALL THOSE HAVING TO DEAL WITH SOILS OF Mid Hawke's Bay, their formation, their agricultural value and the proper use to which these lands should be put to, will find a valuable information in this bulletin It deals with the soil as a physical basis of agriculture, including the problems of soil erosion and soil conservation The scope of this bulletin is well expressed by the chapters like "Soil Forming Factors", "Soil Classification" and "Soil and Agriculture"

The subject-matter starts with a general description of the area which includes natural physiography with climatic data including rainfall, number of rainy days, etc, followed by the soil-forming factors The important soil-forming factors such as climate, topography, parent material and vegetation are treated in detail

It has been shown that in low-rainfall areas of Mid Hawke's Bay, which includes most of the eastern half of the district, parent rock and topography have more influence on the nature and fertility of the soil, whereas in the western portion of the district their influence is less important Topographically the region shows several well-defined units which have great influence on soil formation Vegetation is associated with climate and the distribution of the natural vegetation is related to the amount of rainfall

The soils of Mid Hawke's Bay are classified in 7 groups and some of these groups are further subdivided into series to bring out the degree of development of the soil by studying the soil profile and the detailed analytical data of soil properties, specially the chemical one Thus, they are classified into series, types and phases Nearly 68 series have been described but the profile description of each series is very short and is based in a general way by describing only colour, texture and the consistency

Under soil management, importance of good cultivation is stressed and it is suggested that the methods of cultivation should be adopted according to the soil type The soils have been shown to yield a good stable tilth only within a narrow soil-moisture range, specially with the soils belonging to the yellow-grey loams and rendzina groups Yellow-brown loam groups have a wide range of soil-moisture for cultivation for pasture establishment Soil consolidation is also shown to be a very important factor in cultivation

These soils, in general, are deficient in phosphoric acid but are sufficiently rich in nitrogen content and hence do not need any nitrogenous manure

Under the section of farm crops, a good table showing crops, soils and soil properties associated with each crop type is made

Sheep farming is the chief industry and nearly 95 per cent of the agricultural area are being utilized for this purpose, and it has been classified into three broad groups, namely fattening, fattening combined with breeding, and breeding Bee-keeping is also extensively carried out

Under chapter V, on soil erosion and conservation, different forms of soil erosion are explained and classified according to the intensity of erosion , more destructive forms of soil erosion have been shown to be sheet erosion and gully erosion Gullying has developed to a serious extent on the north-western range A good many examples of erosion have been illustrated by photographs The subject on erosion is treated in a general character dealing with the broad principle of erosion control rather than specific recommendation for local areas on soil condition

A number of soil maps on a scale of one inch to one and a half mile show the extensive work done The book is primarily a monographic treatment of soil and its usefulness will be found more to the soil survey people for the development of agriculture in this area

R V TAMHANE

The Kinetics of Chemical Change in Solution, by Edward S Amis (The Macmillan Company, New York), 1949, pp ix + 332 Price 25*s*

EVEN THOUGH A CONSIDERABLE AMOUNT OF work has been published on the subject, there are remarkably few monographs, the only one dealing exclusively with solutions being the one by Moelwyn Hughes A new addition from a different angle is, therefore, quite a welcome one One is informed in the preface that " when full mathematical formulation is not given there is no attempt to make the necessary steps easy " and " the student who masters this book will have the fundamentals of the kinetics of reactions in solution, both theoretical and applied, well in hand " A perusal of the book bears out the first statement and the advanced student should have no difficulty in following the mathematical part where full treatment is given The second statement, however, is not fully justified

With the briefest treatment of the law of mass action and of Arrhenius's theory (" collision theory " is so unimportant as not to find any reference in the index !), the student is plunged straightaway into the Debye-Huckel theory of inter-ionic attraction followed by an excursion into liquid dielectrics These serve to introduce the reader to Bronstead-Christiansen treatment of the rôle of neutral salts on reaction rate La Mer's treatment of the frequency factor is shown for the reactions studied by the author and for semicarbazone formation The theory of absolute reaction rates finds adequate treatment in a whole chapter and American work on ion-dipole reactions is well presented The second longest chapter in the volume under review is devoted to photo-chemical reactions of which there are so few that have been thoroughly investigated The chapter on homogeneous catalysis again appears to deal essentially with American work on the subject and the same is true of the chapter on heterogeneous catalysis

A general perusal of the volume thus shows that we have here a presentation of American work on reactions in solution, particularly those associated with La Mer's school The student fails to get a complete picture of the subject, much less even of the different parts of the subject One cannot help noticing the inadequate appreciation of the contribution of organic chemists to the development of the subject On the whole, the reviewer feels that one gets a somewhat distorted picture and not what one might expect from the statement in the preface

There are a few misprints in the book that the reviewer came across, particularly in equations, that need correction, e g Eq 5 1 on page 90, 6 14 on p 111, 6 23 on p 112, line 9 on p 147, etc Some of the statements made by the author are not as general as is made to appear For instance, it is not strictly correct to state that " lower activation energies are obtained for reactions measurable at lower temperatures and higher activation energies are found in reactions measurable at high temperatures " (p 92) In presenting the mechanism of hydrolysis of tertiary butyl chloride on p 265, the author has obviously overlooked Hughes statement in his Tilden lecture (*J C S*, 1946, p 970) " Although the importance of solvent in ionic dissociation is recognized, this mechanism is termed ' unimolecular ' because only one reactant, R-X, is undergoing covalency change in the rate determining stage "

With all the limitations the book is none the less a useful publication that will find a place in the bookshelf of one interested in reaction kinetics The printing and get up of the book are quite good

S V ANANTAKRISHNAN

Engineering Development in the Gaseous Diffusion Process (National Nuclear Energy Series) edited by Manson Benedict & Clarke Williams (McGraw Hill Book Co Inc New York Toronto London) 1949 pp 130 Price $ 1 25

THE BOOK UNDER REVIEW DEALS WITH ENGINEERING development in the gaseous diffusion process The work is a survey of the subject and serves as a record of its current status It is an authentic source of information and foundation for any future development that could be brought forth in the field of gaseous diffusion engineering As such it is a valuable addition to the literature dealing with the subject

The work is divided into four parts the first part dealing with Special Plant Instruments and Devices the second with Vacuum Engineering the third with Heat Transfer Equipment and the last with Absorption of UF_6 and Fluorine

The part on Special Plant Instruments and Devices contains the first three chapters of which the first deals with the design construction and performance of recording mass spectrometer for process analysis This instrument is one of the special models of Nier's type of mass spectrometer whose operation is based on the principle of directional focusing The second chapter on recording ionization chamber for traces of radioactive gases gives a detailed design of the ionization chamber and describes this apparatus and its performance The third a chapter on magnetic gear for torque transfer is a brief exposition of the design construction and application of magnetic gear for torque transfer

The second part contains the fourth and fifth chapters The fourth describes two different models of portable mass spectrometers for leak detection The first known as the Nier Kellex general electric detector is a portable version of Nier type of mass spectrometer The second leak detector is a mass spectrometer of new design which incorporates magnetic focusing by means of a solenoid in the source and curved pole pieces in the analyser

The fifth chapter deals with vacuum tightness required in gaseous diffusion engineering plant and leakage in vacuum systems The various types of leak detectors some in vogue before the last war and the rest developed during and after the war are described and their advantages are thoroughly discussed both qualitatively and quantitatively This part dealing with new developments in vacuum engineering should prove very valuable to scientists and engineers who employ vacuum in scientific research technique and industry

The third part dealing with development of leak transfer equipment constitutes the sixth chapter This chapter gives an analysis of condensation from the point of heat and mass transfer and provides the basis for a rational design procedure for a trap used for condensing uranium hexafluoride to a solid form from its gaseous mixture with nitrogen A number of other considerations are outlined for detailed trap design

The last part dealing with absorption of UF_6 contains three chapters the seventh the eighth and the ninth The seventh chapter gives the theory of absorption in a high molecular weight non aqueous system and verifies by quantitative results of experiments on absorption of uranium hexafluoride in heavy oil The eighth chapter describes a plant for continuous fluorine disposal while the last deals with the reaction of fluorine oxide with sodium hydroxide

The book is in general a compilation of the contributions of a group of eminent men of science who developed and worked with gaseous diffusion engineering plants and their accessories Hence it is a record of vast experience in the field of engineering development in the gaseous diffusion process Therefore the book should be a very valuable reference work for both engineering physicists and chemical engineers

Ionization Chambers & Electrical Counters (Experimental Techniques), by Prof Bruno Rossi & Prof Hans H Staub Nuclear Energy Series Volume 2 (McGraw Hill Book Co New York Toronto London) 1949 pp 243 Price $ 2 25

THE BOOK UNDER REVIEW IS A WORK OF TWO distinguished men of science who have made very notable contributions to the development of the science and technique of various forms of detecting devices of nuclear and atomic radiations The authors have very ably dealt with the fundamental features of ionization and discussed the general physical principles underlying the operation of ionization chambers and electrical counters which are most used and essentially the most important detectors of all kinds of ionizing radiations

In presenting the theory of free electrons and ions in gases and the theories of ionization and gas multiplication processes, special emphasis is laid on those features of those theories which have a direct bearing on the principles of the design, construction and operation of ionization chambers and electrical counters

The volume further describes in detail the design, construction, operation and efficiency of some of the beta-ray, gamma-ray, X-ray detectors, alpha particle detectors, neutron recoil detectors, detectors of (n, α) and (n, p), reactors and fission detectors which were developed at the Los Almos Laboratory and other projects connected with the development of atomic energy

The work thus presents not only the theory but also authentic, very important and detailed information on experimental techniques of ionization chambers and electrical counters which can nowhere be found in one single volume The book, therefore, should be very valuable to every physicist who is devoted to experimental research studies in modern physics, especially in atomic physics, nuclear physics and radioactivity The authors should be congratulated for bringing forth this valuable work

SWAMI JNANANANDA

Technology of Light Metals, by A Von Zeerleder (Elsevier Publishing Co Inc, New York)

THIS VOLUME IS A REVISED EDITION OF THE author's earlier publication *Technology of Light Metals* and contains technology of magnesium and its alloys, not included in the earlier edition

The book is divided into two parts In the first part topics of general interest with regard to aluminium and magnesium and their alloys are covered The second part deals with the different fabricating processes

The first part comprises of five chapters devoted to the following topics History and Production of Aluminium and Magnesium, Alloys, Properties and Methods of Testing, Design and Construction and Melting Furnaces Attempt has been made to give the essential details, amply illustrated by tables and curves A comparative idea of the practice existing in respect of testing, design and melting operation in different countries is given Alloys of similar composition manufactured under different trade names in various countries has been tabulated for ready reference Wherever possible, the relative merits of the heavy metals (and their alloys) and the light metals (and their alloys) have been clearly indicated

The second part consists of thirteen chapters covering the following fabrication processes Casting, Rolling, Extrusion, Forging, Drawing of Tubes and Sections, Wire Manufacture, Spinning and Press Work, Machining Practice, Soldering and Welding, Riveting and Surface Treatment The concluding chapter gives an overall picture of the utility of the different alloys in industry and the basis of comparison Each topic has been dealt with very briefly The author's endeavour has been to give the essentials of the different practices and the relative merits of light and heavy metals in respect of these operations The chapters are adequately illustrated with tables and curves indicating the effect of these operations on the physical and mechanical properties of these metals and alloys The advantages of utilizing alloys such as duralumin, silmalec (Aldrey), etc, for specific purposes have been clearly indicated The defects of a few alloys of aluminium and magnesium barring them from general use have been touched upon

In a small volume the author has condensed the voluminous literature available and has made it a hand-book for ready reference The up-to-date bibliography classified according to the topic covered by each chapter is another feature of the book The book is well worth the modest price of $ 7 50

J B.

NOTES & NEWS

Xylocaine, a New Anaesthetic

A HIGHLY SPECIFIC LOCAL ANAESTHETIC Xylocaine, has been developed as a result of investigations conducted at the University of Stockholm (*Studies on Local Anaesthetics* by Nils Lofgren)

Xylocaine (*w*-diethyl-amino-2 6-dimethylacetanilide, $C_{14}H_{22}N_2O$) was prepared by substituting the diethylamino base in *w*-chloro-2 6-dimethylacetanilide which was obtained synthetically as follows One mole of vic-m-xylidine (121 gm) is mixed with 850 c c of glacial acetic acid After cooling to 10°C, 1 1 moles of chloroacetyl chloride (124 gm) is rapidly added to the still clear solution After stirring, a solution of 330 gm of $AcONa\ 3H_2O$ in 1,380 c c of water is quickly added, the mixture being shaken continuously Immediately the *w*-chloro-2 6-dimethylacetanilide precipitates, shaking is continued mechanically for half an hour The precipitate is then sucked off, carefully washed with water and dried in a desiccator or in air The product consists of a white powder and is sufficiently pure for further treatment — the yield is 70-90 per cent The white powder was crystallized from alcohol in thin needles, m p 145° 46°C

The diethylamino base was prepared by refluxing for 5 hr 1 mole of *w*-chloro-2 6-dimethylacetanilide (198 gm), 500-550 c c of dry benzene and 2 6 moles of diethylamine (190 gm) The precipitated diethylammonium chloride was sucked off and washed with a small quantity of dry benzene The benzene and the excess of diethylamine were removed from the filtrate by distillation The residue was dissolved in a little more than the calculated amount of 3N hydrochloric acid (340 c c) After filtering, the solution was purified by shaking out with ether and then made alkaline with ammonia The liberated base was taken up in ether which was removed after drying with K_2CO_3 and the residue distilled under reduced pressure The base was obtained as a colourless oil which solidified rapidly, m p 66°-67°C After recrystallization from petroleum ether (b p 30°-50°), the base crystallized in colourless needles, m p 67°-68°C

Xylocaine is the most stable of all local anaesthetics known and, unlike novocaine, is an injection as well as a surface anaesthetic Its toxicity is lower than that of novocaine The efficiency of Xylocaine is superior to that of novocaine In block anaesthesia, Xylocaine, as distinguished from novocaine, can be used without epinephrine Xylocaine is easily tolerated by novocaine sensitive patients and its local and general side effects are very rare

Role of Tryptophane in Nicotinic Acid Synthesis

A NUMBER OF GREEN PLANTS HAVE been demonstrated to synthesize nicotinic acid from tryptophane (*Science* 1949 **110, 279**) Tryptophane was supplied to intact leaves of tomato and cabbage plants through the petioles Nicotinic acid was determined by the microbiological method using *Lactobacillus arabinosus* as the test organism The time allowed for synthesis to take place was 48 hr Concentrations of *dl*-tryptophane ranged from 0·025 to 0·10 per cent *l*-tryptophane Though no corresponding increase in nicotinic acid was recorded with increase in concentration of tryptophane supplied to the plants, the synthesis of the acid from tryptophane by the plants was established when 4″-5″ tips of tomato plants with their young leaves were put in higher concentrations of tryptophane, the young immature leaves showed unmistakable signs of response to growth hormones They curled up much as they would if the stem had been supplied with indoleacetic or butyric acid It is also shown that light has no effect on the synthesis

Suppression of Axillary Buds in Tobacco Plant

IN THE COMMERCIAL PRODUCTION of tobacco, large-sized and good-bodied leaves are usually required, and to achieve this, the terminal buds of the plants are removed This operation, popularly termed as " topping ", includes the development of axillary buds into " suckers ", which have to be removed to ensure the effectiveness of topping The intensity of topping and the frequency of removal of suckers depends on the type of tobacco grown Since the development of the lateral buds is irregular, the farmer has to keep a close watch continually and remove suckers periodically The process is tedious time-consuming and expensive A simple method of suppressing the development of these axillary branches has been developed at the *Central Tobacco Research Institute*, India

The application of petroleum jelly to the dormant axillary buds withers them in a few days All the varieties of tobacco tried respond uniformly to the treatment In addition to petroleum jelly various mineral oils and fats, both of animal and plant origin, have been tried and found to be effective

The adoption of the method will enable the farmer to do away with removal of suckers and retain a larger number of leaves per plant without affecting their quality

Manufacture of Chloromycetin

A FULL-SCALE PLANT FOR THE manufacture of synthetic chloromycetin has been completed at the Parke Davis & Co 's Laboratories, U S A (*Chem Eng*, 1949 **56**, 107)

The starting raw material is *p*-nitrobrom-acetophenone which is first condensed with hexamethylenetetramine then hydrolysed with ethyl alcohol and hydrochloric acid, and acetylated with acetic anhydride and sodium acetate The resulting product is subjected to hydroxymethylation with formaldehyde and sodium bicarbonate, the product reduced with aluminium isopropylate, then hydrolysed with hydrochloric acid Following neutralization with caustic soda, the isomer mixture resulting is separated by reaction with *d*-camphorsulphonic acid, the desired isomer recovered by neutralization with caustic soda, and the resulting product reacted with methyldichloracetate to yield chloromycetin

The biological method of manufacture is by growing *Streptomyces venezuelae* in nutrient medium consisting of wheat gluten, glycerine and sodium carbonate and sodium chloride, prepared in one of the seven 50-gal pre-seed

Inconel-clad tanks provided with the jacket for steam or chilled water and air sparger The nutrient medium is diluted to needed strength with deionized water and inoculated sterilized The culture grows under sterile air agitation and the temperature is controlled at about 86°F

As soon as fermentation of one of the pre seed charges has been completed, the tank contents are blown to one of the seed tanks freshly charged with sterile medium Air is bubbled through the sparger to raise the internal pressure, under control of a back-pressure vent valve, to about 10 psig and keeping the contents agitated When a seed tank charge has been propagated to the optimum point it is blown with sterile air to one of the 5 000-gal fermenters charged with sterile nutrient medium Here, fermentation proceeds for about 76 hr When fermentation is completed, the contents of the fermenter are discharged by air pressure to 3 000-gal Inconel-lined tanks which serve as feed tanks for the filters Here filter acids and decolourizing materials are added Broth accumulated in aluminium holding tanks is pumped to a centrifugal counter-current extractor where the chloromycetin is extracted in amyl acetate For this purpose the extractor which maintains contact between counter flowing phases of two immiscible liquids at the same time separating the phase by centrifugal force is used The throughput rate for the extractor is about 360 gal per hour of combined liquids, and the total time required for a single batch of broth is about 14 hr The chloromycetinacetate concentrate from the extractor is collected in a 1 500 gal tank of stainless steel and then is concentrated further to about 40 gal in an Inconel natural-circulation evaporator operated under a 0 3 in vacuum Operating temperature is less than 100°F The acetate condensed is returned to process

The concentrate is washed with acid, alkali and water and then charged into a small glass vacuum crystallizer where the remaining amyl acetate is vaporized and condensed at 100°F, and the residue, containing the crude chloromycetin crystals is reduced to a volume of about 2 gal The crude crystal containers are carried to a refrigerated room where they are held for 8 hr at 40°F The material is then manually filtered on a stoneware suction filter and the partially purified crystals are charged in trays into a vacuum dryer for removal of the remaining solvent From the dryer, 6 batches of crystals are combined and charged to a 200-gal recrystallizer, provided with low-pressure steam on the jacket The crystals are slurried with about 70 gal of water and mixed with one tenth their weight of decolourizing carbon Upon heating to 200°F, they go into solution in the water The slurry is then dropped hot to a 12 in Shriver plate and-frame filter press which has been preheated The clarified solution is further treated in a heated Selas ceramic filter and the hot concentrate then flows to an open 75-gal crystallizing tank equipped with a jacket Here the crystallization is completed at about 40°F, using chilled water on the jacket The finally purified crystals are removed to an atmospheric tray dryer and finally to a micro pulverizer for reduction

Although the synthetic process is relatively complex involving 10 reactions and a total of about 30 steps (not including various recovery operations) it has a number of advantages compared to the biological process It requires much less operating space for a comparable output and it is free from contamination problems

Manufacture of Formaldehyde

THE USUAL METHOD FOR THE production of formaldehyde from methyl alcohol has been modified to make possible the recovery of hydrogen and its re use for the synthesis of alcohol (*Chem Age*, 1949, **64**, 418)

Dehydrogenation of alcohol by passage through a copper tube heated by an electric circuit preferably in the presence of water vapour to avoid poisoning of the catalyst provides a method for the recovery of hydrogen mixed with a certain amount of carbon monoxide With the use of oxygen along with catalysts such as copper, silvered copper, platinized copper or silver the process is much more effective Oxidation and dehydrogenation in the presence of hydrogen as diluent give yields corresponding to those obtained from the normal air process but with the additional formation of hydrogen The results confirm the possibility of producing formaldehyde with practically the same apparatus and with the same yield as is normally obtained Air is replaced by a mixture of oxygen and residual gas containing hydrogen, and by increasing the rate or volume of gases in circulation there is very good recovery of hydrogen Since the cost of the oxygen used is less than half that of the hydrogen recovered, the method offers economic advantages

Synthetic Zeolite

THE USE OF SOLAR ENERGY IN THE manufacture of synthetic zeolite has resulted in the revival of the industry and the large-scale use of domestic zeolite softeners in the United States The process employed by Culligan Zeolite Co the biggest U S plant is described (*Chem Eng* 1949 **56**, 92)

The raw materials are 50 per cent soda 42°Bé sodium silicate and bauxite with 1 per cent water or less Bauxite is added to boiling NaOH and heated at 245°F for 45 min The alkaline sodium aluminate is pumped to storage tank and then fed into one compartment of a two-chamber transfer truck Sodium silicate 42 Bé is loaded into the truck's other compartment After driving out across the concrete drying beds the two materials from the transfer truck are pumped separately into another truck the pouring rig proportioning them and diluting them with water (from a piping system through the drying beds) They are mixed in a mechanically agitated tank and the mixture poured out into rectangular steel frame on the ground The zeolite gel sets up in about a minute, the retaining frame is removed and the rig moved ahead to the next spot These operations are carried out by means of a power take-off on the transfer truck The problem in this operation is the packing in the silicate pumps, they have to be repacked once every 2 weeks

The drying beds are about 6 in deep and 20 ft wide The zeolite slabs take 2-5 weeks to dry When it is about a fourth of the way through the drying period, the caked material is washed with water to remove soluble salts and to crackle up the zeolite to about the right screen size The completely dried material is swept up with a mechanical rotary broom into a truck and taken to the mill house for final processing

Filter Paper Pile Column in Paper Chromatography

A NEW AND SIMPLE APPARATUS and technique have been developed for separating mixtures of compounds by the application of dimensional paper chromatography using a pile of filter discs as the absorbing column (*Science* 1949 **110, 278**)

The apparatus consists of 3 parts the pile filter paper itself a clamp for packing the paper tightly and the solvent distributor at the top of the pile The metal parts are constructed from stainless steel The solvent distributor is connected by a siphon of rubber tubing to a flask containing solvent mixture The flask is adjusted so that the level of the solvent is even with the top of the paper pile

To illustrate the utility of the apparatus 50 mg each of adenine tryptophane phenylalanine *p* aminocinnamic acid and anthranilic acid was dissolved in 20 c c of 0 1 N HCl and the solution was placed in the lid of a 100 mm Petri dish Discs of 9 cm Whatman No 1 filter paper were immersed in the solution allowed to drain and hung up to dry in air at room temperature 25 sheets were required to take up the solution and rinsings To prepare for packing the column the bottom plate of the clamp was removed and the clamp placed in an inverted position with the solvent distributor down 40 filter paper discs (9 cm dia) were then placed carefully in the centre of the perforated place followed by the 25 dried sheets containing the sample The remainder of the column was made up of a pile of 8 packages of filter paper (9 cm Watman No 1 total 865 sheets) The column was then placed in the battery jar with the solvent distributor up The distributor was filled with the solvent mixture (3 parts *n* butanol 1 part *tert* butanol and 1 part of 0 1 N HCl) with a pipette and the siphon from the solvent container was connected and filled After 28 hr when the solvent front had descended 13 2 cm the column was removed from the jar and the pile taken out in sections After the approximate locations of the 5 compounds had been determined by qualitative means discs were taken 6 10 or 20 at a time and extracted with hot 0 1 N HCl for adenine tryptophane and phenylalanine and hot 0 1 N NH_4OH for the remaining 2 compounds Adenine tryptophane and *p* aminocinnamic acid concentrations in the extracts were determined with the Beckman spectrophotometer Phenylalanine was determined colorimetrically with ninhydrin and anthranilic acid fluorometrically with a Coleman photofluorometer The total recoveries of compounds from the column sections analysed were adenine 41 mg tryptophane 46 mg phenylalanine 46 mg *p* aminocinnamic acid 44 mg and anthranilic acid 46 mg Thus without considering losses in sheets removed for qualitative tests 223 mg was recovered from the original 250 mg in the mixed sample The most desirable feature of the apparatus is the ease with which a sample can be removed and incorporated into a new pile Thus a section of discs containing a desired compound can be taken out and placed in a new pile for use with a different solvent mixture

New Nomenclature of Elements

The International Union of Chemistry decided at its Amsterdam Conference to adopt new names for a number of elements Tungsten (No 74 in the periodic table) is to be known as wolfram and niobium has been adopted for columbium (No 41) Promethium for No 61 has been approved Names adopted officially for other elements are beryllium for No 4 hafnium for No 72 lutetium for No 71 and protectinium for No 91

The transuranium elements have the names proposed by their discoverers neptunium for No 93 pluntonium for No 94 americium for No 95 and curium for No 96 The 3 other synthetic elements named by the International Union were technetium (43) astatine (85) and francium (87) (*Chem Age* 1949 **61, 481**)

Cashew Shell Liquid Derivatives

2 USEFUL ALKYL PHENOLS HAVE been obtained by hydrogenation of the cashew nut shell liquid (*Chem Age* 1949 **61, 452**) One of the products 3 pentadecyl phenol is a waxy solid pale amber in colour m p of 49° 51°C and a boiling range of 190° 95 C at 1 mm mercury The phenol is insoluble in water and aqueous alkalies but is very soluble in organic solvents including aliphatic hydrocarbons It forms heat reactive resins with an equimolecular amount of formaldehyde and using either acid or alkaline catalysts These one stage resins while in the fusible stage are readily soluble in hydrocarbons including the aliphatic such as naphtha or mineral spirits They are being examined for use as coating resins When heated with concentrated sulphuric acid at 125 C and poured into heptane the phenol easily sulphonates and the product is readily soluble in water and in all organic solvents except cold aliphatic hydrocarbons The sodium and potassium sulphonates are practically insoluble in water but are soluble in a wide range of solvents These sulphonates are suggested as additives for dry cleaning fluids Interesting nitro compounds are obtained from 3 pentadecyl phenol by treatment of a solution of hydrogenated Cardanol in chloroform with fuming nitric acid Both the 4 nitro and the 6 nitro 3 pentadecyl phenols are obtained the first one having a m p of 71 5 72 C and the 6 nitro compound a m p of 43 44 C A tri nitro derivative is prepared by using the disulphonic acid These 3 nitro compounds are soluble in practically all the common organic solvents with the exception of cold aliphatic hydrocarbons for the 4 nitro phenol and of the lower aliphatic alcohols for the 6 nitro compounds The most important amino derivative is the 4 amino 3 pentadecyl phenol made by reducing the nitro derivatives with hydrogen and Raney nickel catalyst in ethyl acetate solution The pure 4 amino compound has a m p of 105 5° 6 5°C while the pure 6 amino phenol has a m p of 133 34 C

The lower alkyl ethers of 3 pentadecyl phenol are low melting solids the higher alkyl ethers (up to octyl) are liquids and the higher alkyl ethers such as lauryl and stearyl are solids of increasing melting point A waxy ether unaffected by boiling alkalies is prepared by combining 2 moles of anhydrous sodium salt of hydrogenated Cardanol with 1 mole of 1 4-dichlorbutane This wax has a m p of 71°-73°C and is insoluble in the lower alcohols but soluble in hydrocarbons It is possible that this waxy ether may be of interest for improving the alkali resistance of wax preparations for treating floors, polishing car bodies and finishing leather

The 5-pentadecyl resorcinol is a waxy solid having an iron or greyish-white colour Its molecular weight is 320 its melting point 91°-93°C, and its boiling range is 220°-25°C at 1 mm mercury

Some of the uses for these products include conversion to oil additives, antioxidants for petroleum fuels, and mutual solvents for the rotenone-containing resins with petroleum hydrocarbons these solutions being used for insecticidal purposes

Fish Storage

AS A RESULT OF EXPERIMENTS conducted at the *Atlantic Fisheries Experimental Station*, Canada it has been found possible to double the keeping time of fish by reducing the storage temperature by only 5° — from 37° to 32°F (*Fisheries Newsletter*, 1949 **8**, 15)

Fish were stored for 10 days at 32°F and at 37°F and periodic measurements were made of the trimethylamine content The concentration of this substance is the best available measure of the extent of spoilage in such fish as cod or halibut When the trimethylamine value reaches 12-15 the fish is beginning to spoil, and between 20-30 it has a definite spoiled odour The results indicate that (i) fish have large number of spoilage bacteria capable of growing at low temperatures and (ii) a few degrees in the temperature of storages make a marked difference in the keeping time of fish, if the range is close to freezing

Leaf-roll Virus in Potato Tubers

STORAGE CONDITIONS WHICH would cure leaf-roll virus-infected tubers have been worked out at *Rothamsted Experimental Station* (*Nature* 1949 **164**, 881) Tubers infected with leaf-roll virus are incubated at 37 5°C in flat open dishes filled with water for various periods The tubers removed from the incubator are stored under normal conditions until they sprout The unheated tubers produced typical leaf-roll plants, those heated for periods between 10 and 20 days showed typical symptoms and none of the tubers that survived 25 or more days heating produced leaf-roll plants

Alumina-paper Chromatography

THE USE OF ALUMINA-IMPREGnated filter paper in chromatographic partition of large water-insoluble organic molecules has been recently described This method has been used in the separation of vitamin A alcohol, esters of vitamin A, retinene and other Carr-Price chromogens (*Nature*, 1949, **164**, 673)

Strips of Whatman No 54 filter paper, which combines great wet strength with a loose texture, are dipped first in an aqueous solution of aluminium sulphate (65 gm per litre) allowed to drain and then dipped in dilute ammonia (2*N*) The immersion in ammonia should not be hurried as the precipitated aluminium hydroxide, by forming a gelatinous layer on the surface of the paper, hinders the diffusion of ammonia into the body of the paper When a heavy impregnation with alumina is desired, the papers may be dipped in stronger aluminium sulphate solution and allowed to hang overnight in a damp atmosphere saturated with ammonia vapour The strips are washed in running tap water for at least 5 hr and are then dried Special drying temperatures and storage conditions are required The activity of the paper however, is not easily controllable, and it is more convenient to run an indicator spot parallel to the unknown on the same strip of paper This indicator may be either a known sample of the substance to be detected or a dye such as one of the Brockmann alumina standardization dyes A calibration curve may be constructed relating the R_F of a suitable Brockmann dye with that of the substance to be detected

Calibration of Photographic Lens

A METHOD FOR CALIBRATING A photographic lens taking into account losses of light from absorption, reflection and scattering within the lens, to obtain a more accurate control of the amount of light admitted to the exposed film, has been developed in the *U S National Bureau of Standards* (*J Franklin Inst*, 1949, **248**, 335)

The method now in use for marking of lenses is based on the ratio of the equivalent focal length of the lens to the diameter of the aperture This ratio, known as the *f*-number, gives no consideration to the great differences in the useful light transmitted by various lenses The new method devised converts each of the markings for a given lens to the corresponding " effective *f*-number " corrected for light losses within the lens

The *Bureau* has also developed a method of testing the marked diaphragm openings so that values that compensate for differences in transmission can be obtained and applied to the scale of *f*-numbers on a photographic lens In this system the markings, known as effective *f*-numbers, are obtained by means of a photo-electric cell and a relatively simple photometric procedure in which the diaphragm of the lens to be calibrated is adjusted to transmit the same amount of light as a similarly placed opening of standard size The standard opening corresponds to an ideal lens of a given aperture ratio in which incident light is wholly transmitted A complete calibration is obtained by the use of a series of openings of graduated size corresponding to various aperture ratio values

Measurement of Wear in Textiles

A CONVENIENT METHOD FOR MEAsurement of the abrasive wear of textiles has been developed at the *U S National Bureau of Standards* (*J Franklin Inst*, 1949, **248**, 336)

The method measures the capacitance of the samples which is very closely related to the amount of material remaining in the portion of fabric tested 3 capacitance measurements are required to determine the extent of wear in a specimen The electrodes of a precision capacitor are first adjusted slightly farther apart than the thickness of the thickest specimen to be studied The capacitance C_a of the intervening air space is then measured The capacitance C_0 with the unworn specimen between the electrodes is next obtained, and finally the capacitance C_R of the abraded specimen The measure of abrasive wear Q is given in percentage by the formula,

$$Q = \frac{C_o - C_R}{C_o - C_a} \times 100$$

Substitute for Activated Carbon

A PHENOLIC RESIN IN GRANULAR form possessing high adsorbent capacity for organic colours and capable of being fully reactivated with dilute alkaline solutions has been developed (*Chem Age*, 1949, **61**, 702)

The usual adsorption operations employed with this resin are column or bed-type percolation, slurry or batch-type application, with subsequent separation by hydraulic, centrifugal or filter-press methods, or in closed "basket" or bag containers immersed in the solution to be heated The types of colour which have been effectively adsorbed include caramel, melanin compounds polyphenols or tannins and food-processing dyestuffs Liquors successfully decolourized include beet, cane and corn sugar solutions, protein hydrolysates pineapple mill juice canning syrups crude glycerine and solutions of edible dyes

At *p*H values ranging from 0 to 14 and temperatures up to 90° C the resin has been found to be effective Strong oxidizing agents high *p*H dissolved oxygen and temperatures are liable to have a harmful collective effect on the resin, but even under difficult conditions of use good results can be obtained The adsorption efficiency of the resin largely depends upon viscosity water-like consistency giving the best results There is a linear decline in activity when the density is raised from 10° to 30° Brix

The resin also promises to be of interest for separating closely related molecules having slightly different degrees of polarity

New Freezing Process

A NEW TECHNIQUE IN ICE MANUfacture that shortens the freezing process from about 20 to 2 hr with a substantial saving in investment and production costs has been developed (*Chem Age*, 1949, **61**, 663)

Heat is abstracted by evaporating ammonia directly from the fresh water moulds instead of through the medium of brine used in the usual process The block of ice thus obtained is of an exceptionally low temperature of −15°C as against −4°C attained in the old method The use of warm gas in the new method (instead of warm water) for defrosting and loosening the ice block from the mould reduces cracking and shrinkage to only 2 per cent

Concrete Composition with Sawdust

A VERY SATISFACTORY INEXPENSIVE light-weight and insulative concrete has been produced using sawdust (*Industr & Eng Chem*, 1949 **41**, 12A)

The mixture comprises cement, clay diatomite and sawdust in volume ratios of 1 1 1 5 All the components except cement are mixed and run through a hammer mill When the final concrete is to be made the water and cement (optimum water cement ratio is about 3) are added and mixed in standard equipment The resulting concrete weighs 58 lb per c ft (compared with 144 for standard concrete) and has a water absorption of 42·6 per cent The compressive strength ranges between 400 and 600 lb /sq in Sawdust used in these tests was a mixture of yellow and white pine, white and red fir larch and hemlock Hardwoods and cedar were unsatisfactory Sawdust weathered for 3 months made stronger concrete than the fresh material Concrete made with fine wood shavings is superior to that containing sawdust, but these are not easily available in plenty

Storage of Groundnuts

RESULTS OF INVESTIGATIONS CONducted on methods of storing groundnuts, with a view to preventing their deterioration during storage, have been published by the *Indian Central Oil Seeds Committee*

The main conclusions are (i) The crop should be harvested when it is fully matured Early harvesting results in a high percentage of shrivelled kernels and of free fatty acids resulting in low oil content (ii) The produce should be dried thoroughly soon after harvest and should not contain more than 5 per cent moisture (iii) The nuts should preferably be stored as pods rather than as kernels If kernels have to be stored, they should be properly decorticated and stored for as short a period as possible (iv) Dry sand to a depth of about a foot provides protection against deterioration (v) The summer crop produce deteriorates faster than that of the winter crop and it should not, therefore, be stored for long, and (vi) proper fumigation of the godowns and the storage material

Agricultural Statistics of India

THE DIRECTORATE OF ECONOMICS and Statistics of the Central Ministry of Agriculture has released a publication furnishing details of agricultural statistics of India covering a period of 10 years ending 1946-47

The publication provides the more important statistical data in the field of agriculture properly correlated to each other and set against the perspective of world conditions Figures according to provinces and states and also according to the principal commodities are given in charts and special maps The provincial tables indicate the area irrigated acreage and production of all crops and information pertaining to different districts and divisions The commodity tables cover the principal food crops, rice wheat, barley, *jowar*, *bajra*, maize, gram and *ragi* and also important cash crops including sugarcane, cotton, jute, groundnut, rapeseed and mustard sesamum linseed, castor seed, coconut, tobacco tea and coffee The tables give statistics of area and yield inland and foreign trade wholesale and retail prices details of information regarding cost of production time of sowing and harvesting, etc

A comparative picture of Indian production in the world setting is also provided by a number of tables showing world production of principal crops In addition, a number of statistical tables are included giving information on the area and population of India, rainfall temperature and humidity, area irrigated, yield of principal crops per acre index numbers of prices, dates of crop forecasts etc Information regarding food values of important Indian crops and statistics of livestock, etc, used for agricultural production is also included

Indian Standards for Lac

THE INDIAN STANDARDS INSTITUtion has prepared three tentative

Indian standards dealing with seedlac, shellac and dry bleached shellac These standards, which are under publication, will also be put up for consideration of the International Organization for Standardization (*ISO*)

The specification for seedlac sets limits for matter insoluble in hot alcohol, colour and bleaching index Only 7 grades of seedlac have been recognized in the standard and the grade designations adopted are independent of the names of host trees and seasons and of other characteristics

In the standard for shellac, 2 types of shellac hand-made and machine-made are recognized and 6 different grade designations are adopted for each of these 4 essential specifications are described matter insoluble in hot alcohol, colour, rosin content and absence of orpiment In addition there are 8 optional clauses supplemented by 16 appendices giving methods for test and analysis of the material

The tentative Indian standard specification for dry bleached shellac covers the requirements of dry bleached shellac which as distinct from hanks bars or ground bleached shellac has a lower moisture content No distinction is introduced in bone dry, kiln-dry, and vacuum-dry bleached shellac in this standard in which only two types, namely (a) a regular dry bleached shellac and (b) refined dry bleached shellac, are recognized The methods of sampling and determination of moisture insoluble and soluble matter in hot alcohol, colour, wax, ash and iodine number are described in 9 appendices

These standards can be obtained from the Secretary (Administration), Indian Standards Institution Delhi

Announcements

The International Scientific Radio Union will hold its 9th General Assembly in Zurich from 11th to 23rd September 1950 Papers on radio science from scientists in South Asia for inclusion in the proceedings should reach the Secretary General of the Union at 42 Rue des Minimes Bruxelles (Belgium), before 1st July 1950

The International Union for the History of Science will hold its 5th General Assembly at Amsterdam from 14th to 21st August 1950 It has been decided to hold a symposium on 'Scientific Relations between East and West from Historical Point of View" Contributions may be sent to the Principal Scientific Officer, UNESCO Science Co-operation Office for South Asia, University Buildings, Delhi

The Federation of American Societies for Experimental Biology will hold its 34th Annual Meeting from April 17 to 21, 1950 at Atlantic City New Jersey Enquiries may be addressed to the Federation Secretary, 2101 Constitution Ave, Washington 25 D C

The Rajasthan Academy of Sciences was inaugurated in Pilani on 27th November 1949 by the Minister for Industries and Commerce with the object of encouraging and promoting the development of pure and applied sciences in the Union Mr M L Shroff and Mr K R Ramachandran of the Birla College Pilani have been elected as the first president and secretary for the year 1949-50

Dr Zal R Kothawala, Dairy Development Adviser to the Government of India has been awarded a medal by the *International Dairy Federation* at the 12th session of the world Dairy Congress held at Stockholm in August 1949 for his outstanding contribution to the science and practice of dairying

Dr Kothawala has also been awarded the "Moos Medal" by the Bombay University for his scientific work on dairy husbandry

Dr Hari Singh Gour — We regret to announce the death of Dr H S Gour at Saugor at the age of 84, on December 25, 1949 An eminent jurist and author, Dr Gour was the Founder Vice Chancellor of Saugor University for the establishment of which he donated Rs 20 lakhs He was the Vice-Chancellor of the Delhi University during 1924 26 and of the Nagpur University during 1936-38

Publications Received

Principles of Electricity (2nd edition), by LEIGH PAGE & NORMAN ISLEY ADAMS, Macmillan & Co Ltd 1948, pp xiii + 619, price $5 00

The Strength of Plastics & Glass, by R N HOWARD, Cleaver-Hume Press Ltd, 1949, pp viii + 245, price 30*s* net

Electronics Experimental Techniques by WILLIAM C ELMORE & MATHEW SANDS McGraw-Hill Book Co Inc, 1949, pp xviii + 417, price $3 75

Spectroscopic Properties of Uranium Compounds, by G H DIEKE & A B F DUNCAN, 1949, pp xviii + 290, price $2 75

Bibliography of Research on Heavy Hydrogen Compounds, compiled by ALICE H KIMBALE and edited by HAROLD C UREY & ISIDOR KIRSHENBAUM, McGraw-Hill Book Co Inc, 1949, pp xiii + 350, price $3 25

An Introduction to the Gas Turbine, by D G SHEPHARD, Orient Longmans Ltd 1949 pp ix + 387, price 24*s* net

The Presentation of Technical Information by REGINALD O KAPP, Orient Longmans Ltd, 1948, pp vii + 147, price 6*s* net

The Measurement of Air Flow by E OWER Chapman & Hall Ltd, 1949, pp vi + 293 price 30*s*

Colours & How We See Them by H HARTRIDGE G Bell & Sons Ltd 1949, pp xi + 158 price 15*s*

Statistics, by N L JOHNSON & H TETLEY, Macmillan & Co Ltd, 1949 pp xii + 294 price 20*s*

Sound Absorbing Materials, by ZWIKKAR & C W KOSTEN, Cleaver-Hume Press Ltd, 1949 pp ix + 174 price $3 00

A General Kinetic Theory of Liquids, by M BORN & H S GREEN, Macmillan & Co Ltd 1949, pp 98 price 10*s* 6*d* net

The Handbook of Textile Industry, by C V S KRISHNAN Bureau of Economic Research, 1949, pp xvi + 429, price Rs 15

Symposia of the Society for Experimental Biology, Macmillan & Co Ltd, 1949 pp vii + 372, price 35*s*

Tobacco Research in India

THE WORK OF THE COMMITTEE'S RESEARCH STATIONS new research and development schemes and other activities are reviewed in the Annual Report for the period ended 1947 48

The Central Tobacco Research Institute Rajahmundry was brought into being during the year Experiments on the following lines are being conducted at the Institute Improvement of texture of seed beds effect of germination and growth of seedlings double transplanting of seedlings effect of age of seedlings on the growth and the quality of the crop spacing experiments topping cum spacing experiments varietal trial of cigarette tobacco and selection in Lanka tobacco It was found that incorporation of sand at the rate of 1 to 1½ cartloads per acre in black heavy soils improved the germination and establishment of seedlings A preliminary study of the distribution of bright grades in different regions of the barn revealed that there was no gradient within the barn from compartment to compartment tier to tier and section to section even though there were considerable random variations within the barn The same held true in the case of percentage of dry matter of the cured leaf

Work at the Cigarette Tobacco Research Station Guntur on topping of the flue cured tobacco showed that the operation improved the yield of the leaf without impairing its quality The stem proportion gained even more than the leaf In the case of *Natu* (indigenous) tobacco the yield suffered where the topping was low The best results were obtained where topping of the flower heads alone was done Two new and better strains viz *H S* 13 and 42 were isolated from Harrison Special and these gave better yields and colour Certain synthetic strains were developed which combine the character of resistance to mosaic disease with high yield and good leaf quality The new material obtained from America was included for study in the appropriate trials and it was observed that some of it e g Chatham Yellow Special and 401 had valuable potentialities for further work Seeds of several *Natu* (indigenous) varieties of tobacco were also collected and grown and selections made for further work Genetic studies indicated that the virescent leaf character of the Burley tobacco is conditioned by three similar recessive genes The use of compost of organic matter for the eradication of *Orobanche* which appeared promising in pot experiment was tried in the field and composts of several species of *Nicotiana* and also of paddy straw and *Datura* were compared with plots without any compost Though no definite conclusions can yet be drawn it seems that the method will not be effective in controlling *Orobanche* Comparative chemical studies revealed that there was a greater consumption of carbohydrates while the nitrogenous constituents were not affected under flue curing process In the slower shade curing process both the carbohydrates as well as nitrogenous materials were used up to the same extent The initial quantity of carbohydrates of green leaves seemed to be associated with quality in different flue cured varieties

Strains resistant to Fusarium wilt by crossing improved strains with wild ones are being tried at the Tobacco Research Station Anand Crosses among the improved *bidi* tobacco strains were also made for study of hybrid vigour The importance of spangles in *bidi* leaves was studied and it was observed that spangles contributed to the sweetness in the smoke while green and greenish yellow areas were responsible for strength and aroma

Work on Virginia tobacco cultivation at several exploratory stations is being continued and the yields smoking qualities and cost of production of tobacco at various stations have been estimated The tobacco grown in Bihar Orissa and Gwalior stations shows promise and indicates the possibility of growing Virginia tobacco in these regions

The Committee approved a scheme from the Government of Bombay for multiplication and distribution of improved strains of *bidi* tobacco K 49 and S 57 to replace Kelin and Saijpuri varieties in Kaira district Gujerat The improved strains are stated to yield 15 to 20 per cent more than their parents

The scheme for tobacco grading has been carried out on proper lines and has created a confidence among the foreign buyers During the period under review the standards for Top Leaf and White Burley tobacco were notified and amendments to the grade specifications of Virginia Sun cured Virginia Sun cured *Natu* (country) and Jutty tobacco were adopted The number of grading centres increased from 13 in 1946 to 53 in 1948 Standard samples of the grades of the different varieties of tobacco were prepared in consultation with the members of the Advisory Panel for reference by the trade and the Inspectorate staff A scheme submitted by the Madras Government for setting up a tobacco redrying factory and a cold store warehouse at Guntur is being considered by the Committee The question of organization of tobacco research in India with special reference to the demarcation of research work to be done at the research stations set up by the commodity committees and the Central Institutions *vis a vis* provincial research stations with a view to avoiding overlapping and waste of effort has been referred back by the Committee to the Government of India for consideration An economic survey of tobacco production in India with a view primarily to ascertain the actual cost of production of tobacco is to be carried out by the Committee in the Guntur area to start with for a period of 2 years

Indian Central Coconut Committee

PROBLEMS RELATING TO AGRICULTURAL RESEARCH on coconut and technological research programmes carried out in various provinces are reviewed in the Third Annual Report (1947 48) of the Indian Central Coconut Committee

Under the coconut research scheme in the Madras province, a study of the performance of adult trees raised from seedlings obtained from different types of palms by " self ' " natural " and cross ' pollinations was undertaken on trees belonging to 6 yield groups viz trees ranging from over 120 nuts per tree per annum to 40 nuts and below " Selfed " seedlings and also those obtained from low yielding parent trees, were the least vigorous There is an indication that seedlings obtained from low yielding parent trees, particularly those yielding 40 and below 40 nuts per tree per year, are less vigorous than those from higher yielding parents The observations made during the current year show the same trends as in the previous years

Observations on the nature of shedding of young nuts (buttons) in relation to varieties seasons, etc, were made on trees of the ordinary tall variety comprising 5 different yield groups ranging from below 40 to above 100 nuts per tree per year, and also on 6 important world varieties Age of buttons at the time of shedding conditions of buttons shed periodicity of the shedding etc were recorded The data gathered show that periodicity of shedding of buttons is almost similar in all the varieties under study There is very little shedding before stigmatic receptivity of the flowers most of the shedding takes place within 6 weeks after receptivity Shedding is maximum from the second to the fourth week In the low-yielding trees shedding is very rapid during the first fortnight unlike in the high yielders About a third of the total number of buttons shed by the ordinary tall variety appears to be unfertilized Appreciable differences are observed in the total production and shedding of buttons the difference being more pronounced in the imported varieties than in the indigenous variety Maximum shedding of buttons took place during the rainy season and minimum during the cold season Shedding was rapid during the hot months and the period of shedding was more spread out during the cold months

As a result of retting trials conducted on husks obtained from 9 10 11 and 12 months' old nuts it was found that the out-turn of fibre from the 12 and 11 months old husks was more than that from 9 months' old husks As regards colour of fibre, 10 and 11 months' old husks yield the best coloured fibre Also from the point of view of length of individual fibres and tensile strength, the fibre from 10 and 11 months old husks was found definitely superior to the others Retting did not influence out-turn of fibre in the different age groups Retting for 9 months was found to be the optimum period required for the proper retting of the husks by the open method of retting

Coir yarn made from the fibre obtained from the previous year's retting trials was subjected to the following treatments and studied for resistance to decay immersed in sea water immersed in fresh water exposed to sun and rain and kept in shade (control) Exposing the yarn to the sun and rain caused the maximum reduction in the tensile strength Gradual weakening of the yarn was particularly noticed as the period of the treatment (exposure to the sun and rain) was prolonged The tensile strength of the yarn kept in sea water was found to remain unimpaired for nearly 9 months

Root Diseases of the Coconut Palm — Under this scheme isolations were made from roots of infected trees and the following organisms were identified *Botryodiplodia theobramae Rhizoctonia solani* and 3 kinds of *Fusarium Sp* Inoculation experiments conducted on seedlings in pots gave negative results Root tips of tender roots of seedlings growing on the ground were exposed and inoculated with the fungi Rotting of the roots thus inoculated was noticed in a number of cases Adventitious roots from adult trees were also inoculated with the organisms Rotting of the roots was observed only in a few cases

The work on soil survey included examination and description of soil profiles, chemical analysis of soil samples from different horizons, estimation of available P_2O_5 and K_2O, base exchange studies and the analysis of clay fractions of representative samples from different horizons 23 samples collected from 7 different localities were studied

Work on the chemical analysis of leaf samples from outer middle and inner whorls of healthy trees and those showing symptoms of the root disease in its different stages was continued during the year Except for a higher percentage of magnesium in the leaves of trees in advanced stage of the disease, there appears to be no significant difference in analytical figures between healthy and diseased trees

In the manurial experiments at the Government Coconut Farm at Oachira 7 lb of groundnut cake and 25 lb ashes per tree gave the best yield At the *Central Coconut Research Station*, Kasaragod, manurial experiments were conducted with graded doses of ash and green manure crops to determine the optimum dosage of ash and to find out the best green manure crop that can successfully be grown under coconut trees *Crotalaria striata* has given the best result Sunhemp has failed *Kolinji* gave a fairly good yield but it was considerably lower than that of *Crotalaria striata* The best sowing time for this is during April-May with the summer showers so that they may be a month old by the time the south-west monsoon sets in They grow well during the monsoon period and become ready for incorporation in the soil in September Cultural experiments indicated that the yield of a neglected plot is very much lower than that of a plot receiving regular cultivation of the interspaces even without manure

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for December 1949.

Organic Chemicals

41858 New azo dyestuffs *By coupling diazotized 4-nitro-4-amino diphenylamine-2 sulphonic acid with a monoazo compound obtained by coupling diazotized* 1-(*m- or p-amino benzoyl*) *amino* 8-*naphtholmono or disulphonic acid with m aminophenol* — I C I Ltd

41956 Production of new amides of pyridine-3-carboxylic acid (accepted on 7th December 1949) *Treating reactive derivative of nicotinic acid with an amine* — Cilag Ltd

42006 New naphthalene derivatives *Conversion of* β-*naphthyl*-(2)-α α *dialkyl*-β *alkyl-propionic acids into the corresponding naphthyl* (2)-*propionaldehydes or propanols by means of reducing agents* — Ciba Ltd

40078 New pyrimidine derivatives *Reacting a substituted aminopyrimidine with a quaternary salt-forming agent* — I C I Ltd

40147 Quinoline derivatives *Comprises reacting a halogen and amino substituted pyrimidine with aminoquinoline* — I C I Ltd

Miscellaneous Chemicals

40007 Production of hydrogen *Passing steam over ferrous oxide above the temperature below which it is unstable and converting ferrosoferric oxide produced into ferrous oxide by passing a reducing gas above the said temperature* — I C I Ltd

41242 Process for preparing an agent for inactivating proteolytic enzymes *Combining an acid-adsorbing resin with an alkyl sulphuric ester* — E I Du Pont de Nemours & Co

Food & Kindred Products

40187 Method of treating water and clarified cane juice or sugar-melt to preventing scale formation in steam boilers, heat exchangers condensers, sugar factory or refinery evaporators *Scale-forming materials are kept in colloidal solution by adding organic colloids and adsorbing the materials which are not kept in solution or in colloidal solution in active surfaces of finely dispersed precipitate* — K L Basu

41534 A process and product for the refining of liquors *With activated carbon deposited on highly adsorbent bauxite, freed from iron salts, by soaking in carbohydrate material subsequently carbonized and activated* — Sutcliffe Speakman & Co Ltd and Tate & Lyle Ltd

41531 Manufacture of raw sugar *By judicious addition of sodium hydrosulphite during the early stages of the process yielding better clarification and economies* — A L Sklar

40416 Preparation of brewers worts *Maintaining the temperature of the wort above its boiling point and introducing it back in the heating vessel* — The A P V Co Ltd

Drugs & Pharmaceuticals

39991 Manufacture of a diastatically active mouldy composition *Providing the fungus with bed consisting of husks, straws, disintegrated bagasse or asbestos supplemented with nutrients* — Raghavendra Rao & Sreenivasaya

41041 Production of aureomycin *Inoculating an aqueous nutrient medium with a culture of Streptomyces aureofaciens under aerobic condition* — American Cyanamid Co

41118 Preparation of acyl derivatives of amino-stilbene sulphonic acids *Acylating* 4 4' *diaminostilbene*-2 2' *disulphonic acid with a carboxylic acid halide of the benzene series in an alkaline medium* — American Cyanamid Co

41324 Recovery of streptomycin *By contacting broths with ion exchange resin containing carboxylic groups followed by eluting of resin with acid* — Merck & Co Inc

39932 Manufacture of (1) Ψ -l-*p*, -nitrophenyl-2-dichloroacetamidopropane-1, 3-diol *Cultivating streptomyces vanezuelae in contact with a nutrient medium and separating* (1) Ψ -l-p-1, *nitro phenyl* - 2 - *dichloroacetamidopropane*-3 - *diol* — Parke Davis & Co

Metals & Metal Products

40974 Production of finely divided metal oxides *A mixture of metal chloride vapour and oxygen-containing gas fed into a reaction chamber is ignited by a separate source of heat within said chamber* — Saurefabrik Schweizerhall

39813 Process for manufacturing cast iron *Raw materials combined in such proportion that lime, alumina and silica contents of slag falls when plotted on Rankin Ternary diagram silica-lime-alumina* — Seailles

41350 Method for production of magnesium by reduction at elevated temperature *Pouring the said magnesium containing substances and the reducer into a slag maintained in the liquid state with the incorporation of either silica or aluminate oil* — Fonderie De Beaufort

Patents of the Council of Scientific & Industrial Research

MAGNETIC SEPARATOR G D JOGLEKAR & L C VERMAN

Indian Patent No 34766, British Patent No 633373, U S A Patent, Pending

THE invention is for separation of finely divided magnetic material from an admixture with other solid non-magnetic material The admixture is introduced into the venturi portion of a conduit through which a stream of gas is flowing and is thereby propelled through a magnetic field in association with the conduit This separates the magnetic material from the admixture by the magnetic attraction of the said field To avoid turbulence, a curved path of uniform section is provided for the passage of particles through the magnetic field The magnetic circuit emanating from the pole pieces is completed through an iron piece (25 in FIG 2) This arrangement provides a continuous magnetic field throughout the curved channel, attracts iron particles thrown out due to centrifugal action and increases the efficiency of the separator

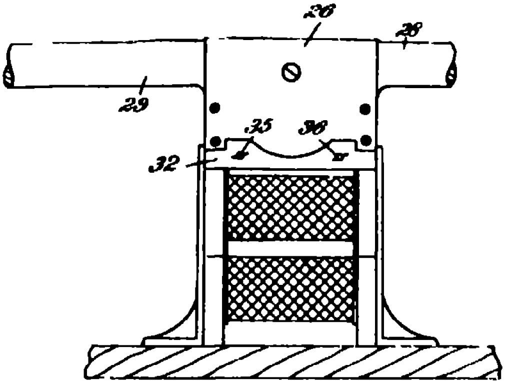

FIG 2

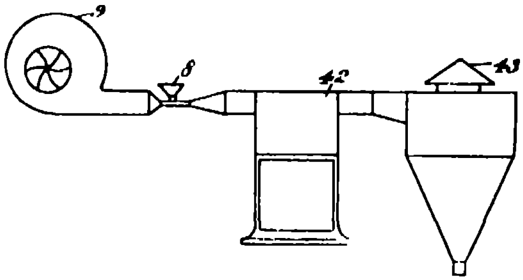

FIG 3

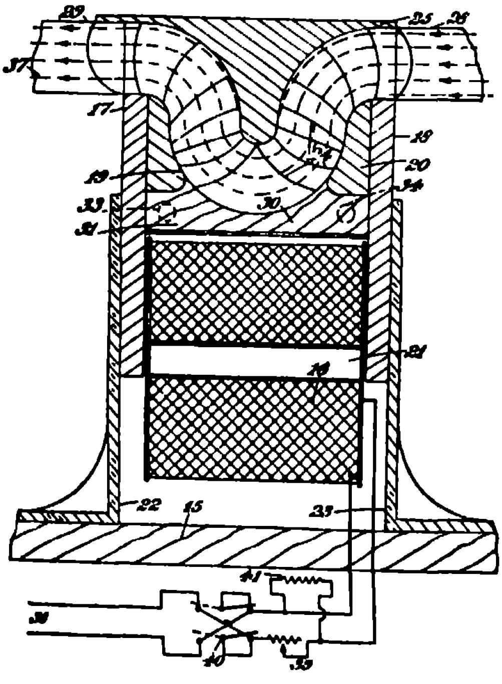

FIG 1

The magnetic separator can be employed with pulverizing mills such as ball mills, or with air separators Such a unit will be of immense value in the manufacture of dry cells and carbon electrodes, in flour mills, paint factories and like industries where fine grinding is resorted to

Statistics in National Planning

THE growing importance of statistics in science and technology, and its rôle in national planning formed the subject of Prof Mahalanobis's presidential address to the 37th Annual Session of the Indian Science Congress (Poona, January 2, 1950) Describing the modern statistical theory as the result of the fusion of two originally distinct disciplines, one primarily descriptive and concerned with the collection of data, and the other essentially analytic and associated with the concepts of chance and probability, Prof Mahalanobis evaluated the pre-eminent status that statistics has come to occupy as a practical instrument in the solution of our vital national problems

Pointing out that the statistical system is a visible mark of the economic and political frame-work of each country, he gave an account of the very high state of statistical developments in India in the third century B C , in the time of Akbar in the 16th century A D , and in the British period in early 19th century

On the theoretical side, he emphasized that all scientific knowledge was based upon measurements and observations which represented only one portion (or a sample) of all conceptually possible sets of measurements Scientific knowledge (being based on formally incomplete evidence) was thus only probable and never absolutely certain In principle, statistical theory supplied the real foundation of all inductive inference

The scope and range of statistical method in the concrete may be represented conveniently by constructing " a kind of mental map of scientific activities " Taking pure mathematics (which being fundamentally deductive in nature does not itself belong to the field of science) as a point which has position but no dimension, Prof Mahalanobis draws concentric circles around the point to demarcate areas representing (1) physical sciences , (2) kinetic theory of gases, statistical mechanics and thermodynamics , (3) biometry , and (4) statistical sampling With the increase in the distance from the centre, the factors of variation grow more complex and less amenable to experimental control A 5th circle can be added to indicate the area in which factors of variation are neither amenable to control nor to experimentation, not even, in the usual sense of the term, to sample surveys or sample censuses Here the only possible approach is the patient collection of observations, followed by classification and painstaking investigation of possible statistical relationships Experimentation is no longer possible, but it is still feasible to compare predictions with subsequent observations Statistical methods are particularly appropriate in this field

Social Background of Statistics

The importance of statistics in the field of science is due to its supplying the general methods of inductive inference The growing importance of statistics in public estimation, on the other hand, is mainly due to its increasing practical applications in the affairs of every-day life In statistical research, the greatest stimulus has always come from the need of solving practical problems Fisher's work on the design of experiments was necessitated by the urgent need of solving the deadlock in agricultural field trials Shewhart's work on quality control arose from the need for improving the efficiency of inspection in large-scale production On the organizational side also, statistical work is closely determined by the special needs of the country and by the socio-economic framework The science of statistics is not only an applied science, but is also a public science and it is because of the close connection with public activities that big developments in statistics have always taken place as will be evident from a critical review of the growth of statistics in the U S A, U K and U S S R during the last two decades

The Food Crisis in India

Paucity of and, in some cases, the total absence of adequate statistics has been responsible for the inadequacy of results arising from the efforts that have been made to solve many vital national problems " The biggest single problem in India at present is the shortage of food The food position can be judged only in relation to population and other resources of the country We know the total geographical area of the Indian Union It is about 1 22 million sq miles On the available information, the total population at present would seem to be something between 34 and 35 crores The density of population is thus very high, something like 290 per sq mile, which is bigger than the density in most countries of the world with the exception of the highly industrialized countries in western Europe and Japan The pressure on land is many times greater in India compared to other countries, with a large population The population is also increasing at a rapid rate Between 1931 and 1941 the rate of increase was 1 4 per cent for the Indian Union If this rate is being maintained, the population of India is increasing at present by about 5 millions every year

" About population we have some information The position is much worse about food statistics We really do not know the *real* position regarding food production in the country There is some indirect evidence Actuarial estimates on the basis of the decennial censuses between 1881 and 1931 show that there has not been any appreciable increase in the expectation of life at birth which hovered round or below 25 years during this period This suggests that, although population increased at a rapid rate, there was no over-all improvement of the vitality of the people

" The famine in Bengal in 1943 was also an ominous indication From the information collected in the course of a sample survey of famine conditions, I believe the total number of deaths was something between 1 25 to 1 5 million In 1943, the area of the undivided province of Bengal was about 78,000 sq miles, and the estimated population about 63 millions The density was thus of the order of 800 per sq mile, which was higher than that in even the most highly industrialized countries in the world The terrible pressure of population was a predisposing factor in the famine

" In 1943-44, the year of the Bengal famine and the first year of introduction of food rationing, the net food import was quite small, only about 1 8 lb per head per year During the last five or six years, the position has grown steadily worse The net import rose to about 18 lb per head in 1948-49 and the expenditure incurred was something like Rs 120 to 130 crores The significance of this figure can be appreciated when it is recalled that the total revenue budget of the Government of India in 1949-50 is of the order of Rs 320 crores

" Another aspect of the problem is even more serious If the food production and the home consumption remain constant, then the surplus coming to the market would also remain constant In this situation, the total import should increase in proportion to the growth of population In actual fact the import rose from 0 33 million tons in 1943-44 to 2 78 million tons in 1948-49, an increase of more than eight times in five years This definitely shows that the supply coming into the market (through procurement or otherwise) has been steadily decreasing This is the most alarming feature of the present situation

" What is the solution ? There is obviously no single remedy The problem has to be attacked on many fronts, and statistics can help on all fronts . . First, every efforts must be made to increase the crop production Fertilizers, improved seeds, irrigation and better methods of cultivation are already being used and must be pushed much further Experimentation at the research level in agricultural field trials must be continued and developed with close gearing to actual conditions of cultivation Another possibility is the improvement of varieties through fundamental research in genetics The spectacular increase in the yield of maize is a striking example of the success of such researches Rice offers a promising field for similar work, and an increase of 25 or 30 per cent in the yield is a definite possibility Well-equipped centres for the study of rice genetics should be, obviously, established without delay Here statistics can render effective help In fact, in the field of agricultural experimentation and genetics, powerful methods like the design of experiments, the analysis of variance, and the theory of estimation are already available

" It is certainly necessary to attain self-sufficiency in food in 1951 But this is not enough The production of food must keep pace with the growth of population But not only food , it is also necessary to produce new houses, clothes and thousands of other things in increasing quantities Production must keep pace with population The future trend of population in India is, therefore, a matter for serious concern Available evidence indicates that at the existing level of production, the balance has already become adverse A further and continual growth of population without a commensurate growth in the means of production will be disastrous The only way is to develop our national resources

Industrial Development

" Rapid industrial development is one possibility Work on a number of big multipurpose dams for both irrigation and power has already started A beginning has also been made with machine tools and other basic industries and heavy chemicals The building of houses, electricals and other innumerable industries (including production of consumer goods) must be stepped up All this would require goods in the way of plant and equipment, land and buildings and labour

" It would be useful to obtain even a very rough idea of the capital requirements The ratio of the gross value of the annual product to the capital investment varies widely from one industry to another The ratios would be small in the case of iron and steel or basic industries , the gross value of the annual product may be something like ⅓ or ¼ or even ⅕ of the invested capital In electricals and lighter industries the ratio may be unity or even higher Unfortunately, very little information is available As a rough guess the over-all value of the ratio is likely to be something between ⅓ and unity

" It is also necessary to take into consideration what the economists call the ' multiplier ' effect To put it crudely, the multiplier stands for the additional value of products, and business and other activities stimulated by the increase in the primary product (For example, an increase in the production of steel and cement may be expected to lead to an increase in the building of houses and construction work and other industries in an indirect way) No information is available about the value of the ' multiplier ' in India It is sometimes guessed that the multiplier may be something like 1 5 or so To get a dimensional figure, we may perhaps assume that an investment of, say, one crore of rupees would lead to an increase of an equal amount in the national product (inclusive of the ' multiplier ' effect) The actual ratio may be somewhat higher or somewhat lower, but this would give a rough dimensional picture

" Consider the implications To increase the value of the national product by one rupee per head per month or, say, twelve rupees per head per year, it is necessary to invest 420 crores of rupees (= Rs 12 × 35 crores) or £ 310 million sterling Compare this figure with the budget of the Government of India which is something like Rs 320 crores (£ 240 million sterling) in 1949-50 Even if this whole amount is used for industrial development, the value of the national product is not likely to increase by more than, say, twelve annas or a rupee per head per month It is clear that the Government of India alone can do very little The industrial development of India depends entirely on the efforts which the people of the country are prepared to make

The Over-all Picture

" This survey conveys an idea of the magnitude of the task in front of us It brings home also the need for more and better statistics Along with the efforts to increase food production, attempts must be made to improve the statistics not only of the production of food but of its consumption and distribution A gap of 10 years between population censuses is no longer tolerable It is necessary that we should have information about the growth of population every year We require information about distribution of income and expenditure in different sectors of national economy, and in different strata of the population We must, in fact, set about earnestly to develop a comprehensive system of social accounting for the whole nation

" If the statistical picture I have placed before you is not hopelessly wrong ", concluded Prof Mahalanobis, " then we are in difficult times and are probably facing greater difficulties than we have ever done in the past The united efforts of the Government with the people can save us Such united effort can be brought about by a concerted action To prevent waste of money, effort, resources and most critical of all, to prevent waste of time, planning on a national scale is essential

" National planning has several aspects First, there is the preparation of plans at the technical level requiring help and co-operation of workers in every branch of science and technology Statistics is indispensable at this stage for the supply of basic information Secondly, the individual plans have to be built into a general plan Here statistics is the common denominator and supplies the common binding medium for the whole Thirdly, the plan has to be implemented At this stage also, statistics can help in two ways Firstly, by establishing scientific controls to ensure the programme of action proceeding on efficient lines Secondly, by conducting continuous assessments of the results by keeping account of the input of money, effort and resources, and measuring what is obtained in return The process is never ending In the actual working of the plan defects are revealed, and new possibilities emerge requiring consequential changes Statistics is again invaluable in diagnosing weaknesses in guiding controlled experiments and in suggesting improvements Statistics is thus an integral part of the dynamics of national planning

Hopeful Signs in India

" The progress of statistics must, therefore, depend upon, and is closely determined by, socio-economic trends In India we have seen during the last one year hopeful signs of advance A Standing Committee of Departmental Statistics with representatives from the different Ministries of the Government of India was established in October 1948 A Central Statistical Unit was created under the charge of a Statistical Adviser to the Cabinet on 28th January 1949 For the first time a permanent office for the Census and Vital Statistics was established under a Registrar General and ex-officio Census Commissioner in May 1949 A comprehensive report on the industrial census of 1946 was published in July 1949 A National Income Committee was set up in August 1949 to review the position in this field and make such estimates as may be possible And the Central Statistical Unit was converted into a Central Statistical Organization on December 21, 1949 All this indicates a move towards a more comprehensive review and formulation of the economic policy of the country

" Our vast population is a great asset, but only in a potential form In India we have every year a vast quantity of water in the form of rainfall Most of it is wasted Sometimes, in times of flood, it becomes a menace But by building dams and hydrauls we can put it to work and make it a source of power for fruitful production In the same way our vast man-power is at present lying mostly stagnant A great deal remains idle, and a great deal is wasted in inefficient production Perhaps it is wise to remember that, out of control, it may also become a menace fraught with grave dangers of self-destruction But, if we can harness this living reservoir of power, there is nothing which we cannot accomplish

" So far attempts have been made to hire this power in a market place We should think seriously whether we have the means, or the time, to continue to do so Conditions are changing rapidly It is a matter for serious thought whether or not the wiser policy would be to rally the common man into a great effort for national welfare We look to our political leaders for guidance decision and action

In a national plan scientists and technologists also have to make their contributions They can give the labour of their thought and by the skill of their research and experimentation show how to overcome difficulties and open out new possibilities The statisticians have a humble rôle but they also can help in reaching vital decisions To this great task I call all my friends and colleagues

British Commonwealth Collections of Micro-organisms

BY DECISION OF THE SPECIALIST CONFERENCE held in London in 1947* a British Commonwealth Committee was established to promote the preservation of micro organisms in collections readily accessible to workers in all parts of the Commonwealth The initial task was to find out what cultures were being kept in collections university departments and other laboratories when this was completed attempts would be made to fill the lacunae revealed

Questionnaires were sent to laboratories in all parts of the Commonwealth asking for information on the number and types of micro-organisms maintained and whether these would be made available to other workers The response to this questionnaire was variable but sufficient progress was made to justify publication of a Directory of Culture Collections in the United Kingdom About 90 collections are named in the first edition of the Directory which is to be supplemented by a List of the species maintained by them

National Committees have been appointed in most of the co operating countries and it is anticipated that similar Directories and Lists will be prepared for other parts of the Commonwealth All workers who have specialized collections or who maintain cultures for teaching purposes are asked to co operate by getting in touch with their National Committee from whom copies of the first edition of the U K Directory can be obtained The Convener of the Indian National Committee is M Sreenivasaya Asst Professor of Fermentation Technology Indian Institute of Science Bangalore 3

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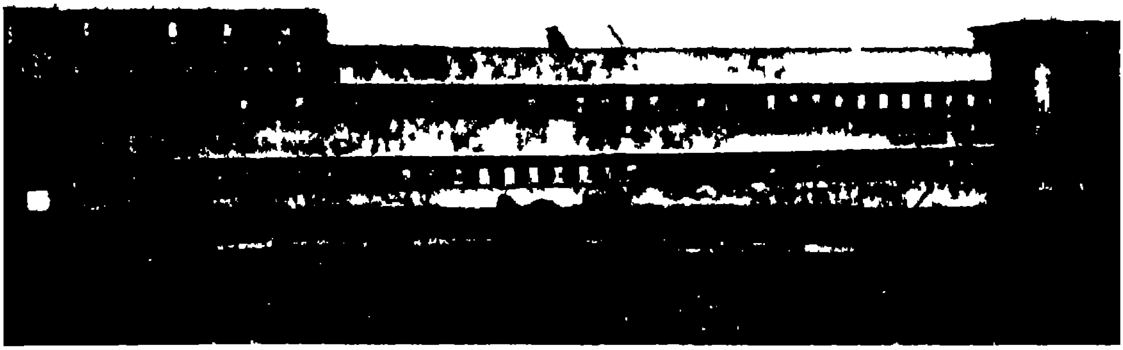
* Report of Proceedings published by H M S O Code No 47 139 price 6*d* net

THE NATIONAL CHEMICAL

OPENING CEREMONY,

THE opening of the National Chemical Laboratory at Poona the first in the chain of eleven National Laboratories planned by the C S I R is a landmark in the history of scientific development in India The event which took place on January 3 1950 was celebrated with a grandeur befitting its importance and Pandit Jawaharlal Nehru Prime Minister of India declared the Laboratory open in the presence of a large and distinguished gathering of Indian and foreign scientists including Sir Robert and Lady Robinson Prof Desmond Bernal Prof and Madame Curie Juliot Prof Herman Mark Dr E U Condon Prof P Auger Chancellor Arthur Holly Compton Prof O E H Rydbeck and Dr S Trone H E Raja Sir Maharaj Singh presided

The National Chemical Laboratory whose work is directed by the distinguished physical chemist Prof James William McBain F R S owes its existence to the far sighted vision and indefatigable energy of Dr S S Bhatnagar Chemistry is a live subject with abundant and ever growing applications in agriculture and industry This discipline in the modern sense came into this ancient land rich with scientific traditions in the opening years of the present century and thanks to the pioneering efforts of Acharya Profulla Chandra Ray the Doyen of Indian chemistry it took firm root In the early years material facilities for scientific research were few and the number of workers limited With the passing of the Universities Act in 1904 the teaching of science received a stimulus and research facilities in university laboratories gradually improved The impetus given by World War I to the development of Indian industries created also a demand for trained chemists and the establishment of the Imperial Council of Agricultural Research and the technical laboratories associated with it as also the School of Tropical Medicine All India Institute of Hygiene and Public Health the Nutrition Research Laboratory and the Indian Institute of Science helped to widen the field covered by chemical research in India Following the lead given by Acharya P C Ray important schools of chemistry headed by his distinguished pupils sprung up all over the country and many important contributions both in theoretical and applied chemistry were made to chemical literature by Indian chemists The physical chemistry of colloids magnetic properties of chemical



LABORATORY, POONA

JANUARY 3, 1950

compounds Raman spectra chemistry of terpenes and terpene derivatives natural dyestuffs plant and animal products including oils and fats alkaloids active principles of medicinal plants etc received attention The importance of biochemistry in relation to human nutrition animal husbandry and agriculture was recognized and this branch of chemistry made rapid progress In the field of industrial chemistry too notable contributions were made and Departments of Applied Chemistry were established in many Indian universities

The growth of chemical research in its early expansive phase was necessarily *ad hoc* Its shortcomings became manifest when the second World War broke out in 1939 and the necessity for mobilizing all scientific resources for the war effort became compelling Such attention as had been given to planning and organization of scientific research in the past fell far short of the requirements There were few established laboratories attached to industrial concerns in India as for instance in the U K in which the Government could plant their research on the pattern set by the larger industrial concerns The Government of India established the Board of Scientific & Industrial Research in 1940 and invited Prof S S Bhatnagar to direct its activities This decision was a happy one pregnant with possibilities Within one year of its inception the Board under the dynamic leadership of Dr S S Bhatnagar completed a survey of the research facilities available in the country ascertained the shortcomings assessed the requirements and put forward proposals for organizing scientific research on a scale adequate to meet the requirements of the country These proposals which were characterized by bold imagination and constructive realism included firstly the harnessing of facilities available in university laboratories and research institutions all over India through financial aid for specified and approved schemes of research and secondly and this is the more enduring proposal which has received worldwide acclamation the establishment of a network of National Laboratories planned with due regard to the needs of both scientific research and progressive industry

That the needs of research vary with the evolutionary growth of science is not always recognized Modern scientific research is costly and demands a big investment Explorations into the mines of knowledge reveal new treasures which have to be won through new techniques and new strategies Systematic pursuit of science involves teamwork in which the multiple facets of a problem are concurrently investigated, and demands abundant and specialized facilities both in equipment and in the quality of personnel Leadership in science to be effective should take these factors into account, and in addition, also the changing requirements of productive enterprise, be it agriculture or industry These are the considerations which have gone into the planning of the new National Laboratories

In the establishment of the Laboratory at Poona, the House of Tata took a keen interest and generously donated a sum of Rs 8,30,000 In 1944, the Government of India allocated a sum of Rs 25,00,000 for building and other capital expenditure and the sum had to be considerably increased on account of higher costs The Foundation Stone was laid on April 6, 1947, and the construction of the building started in February 1948 In March 1949, some sections of the Laboratory, which were functioning in the Council's Laboratories at Delhi since 1940, began work in the incomplete building nearing completion Professor James W McBain, F R S, Emeritus Professor of Chemistry, Stanford University, U S A, joined as Director in October 1949

PROF JAMES W McBAIN, DIRECTOR, NATIONAL CHEMICAL LABORATORY

The Laboratory is equipped for research in both pure and applied chemistry and functions through eight Divisions, viz Organic Chemistry, Biochemistry, Chemical Engineering, Plastics and High Polymers, Inorganic Chemistry, Physical Chemistry, Standardization of Chemicals and Survey and Information One of the most important functions of the Laboratory will be to work out ways and means for the application of scientific knowledge to practical problems of human welfare In the words of its Director "We have in the creation of this Laboratory tangible evidence of the far-seeing aims and hopes of India, that have gone into the careful planning and building of these splendid laboratories India is using her newly won freedom to turn to science for the amelioration of the conditions of life of her people, and to participate in the progress of Western civilization Here I would at once emphasize that science and applied science need introduce no conflict with the highest spiritual and ethical traditions of humanity, but must be integrated with them"

In declaring the Laboratory open, the Hon'ble Prime Minister pointed out that during the last two or more years the Government of India had done something substantial in the matter of scientific research "I think it is rather an exciting conception to see large numbers of young men and women coming into the laboratories and research institutes in India and working with zeal and enthusiasm for the advancement of Indian people" He exhorted the leaders of industry to shake off their indifference to science, and to recognize the importance of science not only in their own interests but in the interests of the country

The National Chemical Laboratory has on its staff a team of trained and tried chemists It has in Prof McBain a Director known the world over as a distinguished physical chemist with mature experience in planning and directing research projects Its work is dedicated to the advancement of an exhalted subject, which, in Sir Robert Robinson's words, "stands high in its own right as the science of transformation of materials giving necessary knowledge whenever useful products have to be isolated or synthesized purified characterized or evaluated But it is also an essential handmaid of other disciplines and occupies a strategic position between the basic physical groups and biological science The Laboratory is well planned and equipped Its functions and scope are wide and to quote the words of Sir Robert Robinson once again embrace all the chief applications of chemistry with due attention to the advance of the fundamental science itself This happy combination is very significant for I am sure that the applications to be made in ten years time will depend at least as much on the new knowledge uncovered during the period as in making better use of what we already know Started under such good auspices and enjoying such abundant good will from scientists all over the world there is every reason for hoping that through its work the nation would be strengthened and the life of the people would be enriched

PANDIT JAWAHARLAL NEHRU OPENING THE LABORATORY

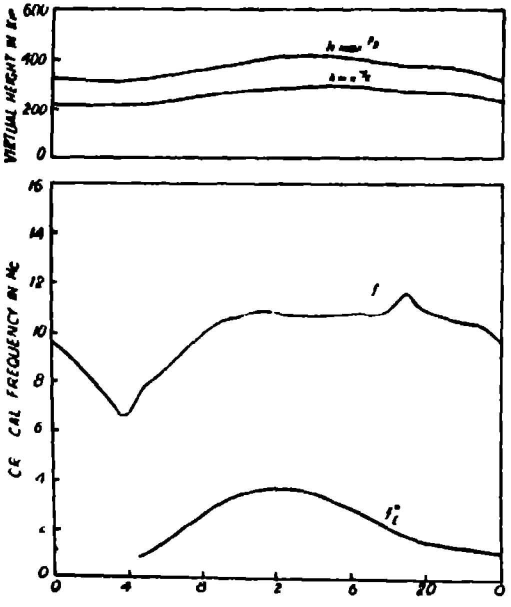
Characteristics of the Ionosphere over Calcutta (December 1949)

S S BARAL, R K MITRA, D C CHOUDHURY, (MRS) T K BHAR & A P MITRA

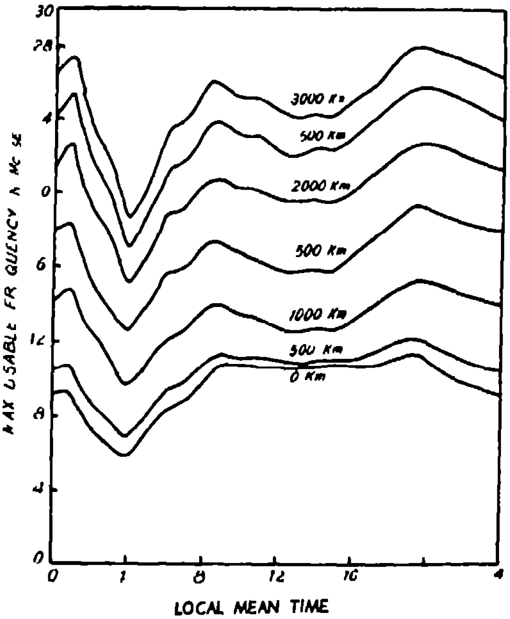
Wireless Laboratory, University College of Science, Calcutta

THE following are the ionospheric data observed at Calcutta for the month of December 1949

Fig 1 represents the mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of March 1950 Table I gives the different occasions during routine observation when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights



(5 HR 54 MIN AHEAD OF G M T)
FIG 1 — DECEMBER 1949



AT POINT OF REFLECTION
FIG 2 — PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF MARCH 1950

Sporadic E ionization was found to occur frequently during afternoon and early part of the night Absorption of normal E echoes at mid-day was found to be small There was an increase in region F_2 ionization after sunset on most of the days in this month

TABLE I

MONTH & YEAR	DATE	HOUR	$f^{\circ}E_s$ Mc	h_{E_s} Km
December 1949	3	20 00	3 35	105
		22 00	2 80	90
	5	18 00	3 25	105
		22 00	1 35	105
		23 00	1 00	90
	7	17 00	3 00	120
		18 00	3 25	105
	9	18 00	5 50	135
		20 00	3 20	120
		21 00	3 10	105
		23 00	3 00	90
	12	21 00	2 50	105
	13	21 00	2 00	105
		22 00	3 00	105
	15	17 00	3 30	120
		18 00	3 25	120
	16	15 00	4 80	135
		16 00	3 50	120
		17 00	3 20	120
December 1949	16	18 00	3 00	120
		22 00	4 00	120
		23 00	4 00	120
	17	08 00	4 00	120
		09 00	4 00	120
	19	16 00	3 30	120
		17 00	3 20	120
		18 00	3 00	105
		21 00	3 40	105
	20	18 00	3 90	105
		21 00	2 60	105
	22	17 00	3 65	120
		18 00	3 20	105
	23	20 00	3 20	105
		21 00	3 35	105
	24	12 00	4 40	135
	27	12 00	4 70	135
		16 00	4 10	135
		17 00	3 85	135

On the Vapour-Phase Production of *p*-Cymene

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p CYMENE 1-methyl-4 isopropyl benzene, occupies an important position among the aromatic hydrocarbons It is a frequent constituent of ethereal oils and is synthesized in a variety of ways Besides a satisfactory thinner for paints, varnishes lacquers and a solvent, *p*-cymene is the starting point for a number of products thymol, carvacrol, camphor, *p*-tolylmethyl ketone, *p*-menthane dyes, acids alcohols styrene derivatives, resins emulsifying and antiknock agents, photographic developers explosives, etc[1,2] It is the purpose of this paper to review the work on the vapour-phase production of *p*-cymene No attempt has been made to present here a complete bibliography, but the most significant contributions to the subject have been cited

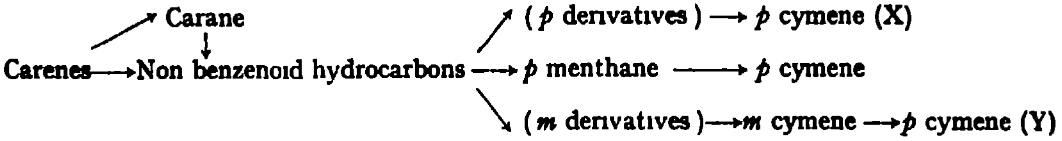
Recovery from Sulphite Turpentine — The principal constituent of sulphite turpentine in the manufacture of wood pulp is *p*-cymene[3,4] Its formation is perhaps due to the ring fission and dehydrogenation of the terpenes in the original wood by the action of free sulphur or acid or both known to be present in the digestor liquor, or by the oxidation of the terpenes to alcohols which are then dehydrated by sulphur[7,8] pinene → dipentene → terpin hydrate → terpineol → terpinene → *p*-cymene

The recovery of *p*-cymene during sulphite cooking is a well-known process During World War I, a considerable amount of this material was recovered to manufacture toluene and related compounds However, this was not the case in World War II In the sulphite mills in Germany, Norway, Sweden and Finland in the summer of 1945, there was no indication of any recovery of this material[9,10]

A Committee of the Canadian Pulp & Paper Association to investigate the availability of *p* cymene in Canada found that due to the methods of heat recovery from the waste liquor in use in modern mills and to the resulting extremely low yield of *p*-cymene, the production of this chemical from sulphite waste liquor was uneconomical[10].

Terpene Hydrocarbons — Terpene hydrocarbons of the group $C_{10}H_{16}$ have been extensively examined for the vapour-phase production of *p*-cymene This group embraces the monocyclic terpenes like menthenes and methadienes, and the bicyclic terpenes like pinenes and carenes The monocyclic terpenes have the same carbon framework in the nucleus as *p* cymene and the bicyclic terpenes can attain it by fission of the double ring contained in them[11 13] rated hydrocarbons like carane and menthane and these also get dehydrogenated to *p* cymene at the pyrolytic conditions[12,15 20]

All these transformations may be summed up by the following general scheme



The hydrocarbons important from the point of view of *p* cymene manufacture are pinenes carenes pinane carane limonene phellandrenes terpinenes *p* menthane or similar terpenic bodies or mixtures of these e g oil of turpentine spent residue of essences sulphate turpentine

Pinenes and carenes are available in large quantities from oil of turpentine they are convertible to pinane and carane respectively by addition of a molecule of hydrogen at the double bond and to monocyclic terpenes under various conditions The monocyclic terpenes also occur in many essential oils they are recovered in substantial amounts from wood distillation industry and are hydrogenated catalytically to *p* menthane[13]

Dehydrogenation (i) *Pinenes* — Zelensky and co workers[14 16] pyrolysed *d* or *l* pinene with carbon dioxide over I d asbestos at 190° 200°C and then over Pt charcoal at 300°C At the lower temperature the hydrocarbons undergo simultaneous dehydrogenation and hydrogenation to *p* cymene pinane and *p* menthane The preponderating reaction at 300°C is dehydrogenation to *p* cymene β pinene also passes through analogous transformations presumably after isomerization to α pinene

Subsequent studies with Pd and Pt[17] and Ni and Cu[18] catalysts are in conformity with the above observations

(ii) *Carenes* — The formation of *p* cymene from carenes appears to involve (a) the two directional rupture of the trimethylene ring and isomerization to intermediate non benzenoid hydrocarbons and (b) the elimination of hydrogen from them with or without the migration of the isopropyl chain[12 15 19 24]

Partial hydrogenolysis also occurs by the nascent hydrogen released during the course of the disproportionation resulting in saturated hydrocarbons like carane and menthane and these also get dehydrogenated to *p* cymene at the pyrolytic conditions

Route (X) would involve the breaking of the C_3 C_8 linkage and a similar fission of the C_4 C_8 would account for route (Y) A notable distinction of the two types of fission is the more facile character of the mode of fission in favour of route (X)

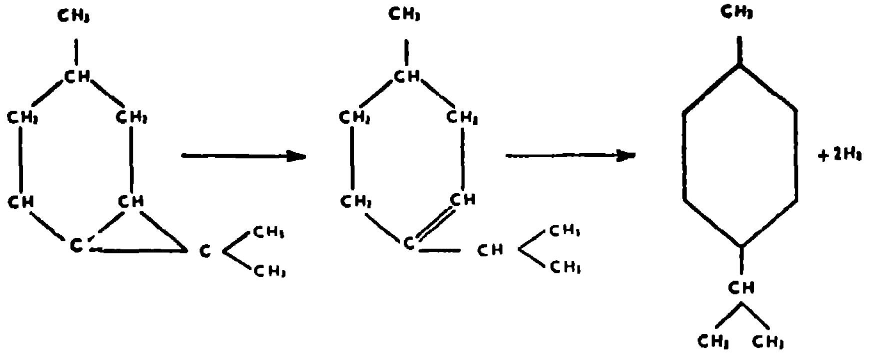
(iii) *Pinane* — With Pt charcoal at 300°C pinane is dehydrogenated to *p* cymene[16 17] When passed over Pt Al_2O_3 or Pt pumice or Pt charcoal at an hourly liquid space velocity of 0 2 dehydrogenation takes place to yield a complex mixture of liquid products and gases consisting of hydrogen and methane[25] In addition to *o* and *p* cymene depending upon experimental conditions the liquid products contain 1 2 4 and 1 2 3 trimethyl benzene 1 1 2 3 and 1 1 2 5 tetramethyl cyclohexane and 1 2 and 1 4-methylisopropylcyclohexane[25] Other workers[15 17 26] have also pointed out the presence of a small amount of *o* cymene on dehydrogenation of pinane with such catalysts as Pt charcoal Pt asbestos and nickel

(iv) *Carane*—This saturated bicyclic hydrocarbon with Pt charcoal at 300°C in the presence of CO_2 passes through the following changes

This result is of great significance since the meta compound the other probable product from carane gives by rearrangement only para compounds[15 23]

(v) *Limonene Phellandrenes Terpinenes & p Menthane* — Limonene undergoes disproportionation into *p* menthane at comparatively low temperatures (< 205°C) over Pd Pt[17 27] Ni and Cu[18 28] catalysts However Komatsu and Kurata[26] claim quantitative conversion of the hydrocarbon to *p* cymene over Cu catalyst at 280° 300°C

The action of Cu catalyst[29] on β phellandrene and of Pd catalyst[16] on α terpinene takes similar course of transformation resulting in aromatic and saturated counterparts



Very little work is done on the dehydrogenation of *p*-menthane to *p*-cymene Ipatieff and co-workers[28,29] subjected it to the action of Pt-Al_2O_3 catalyst at 230°C , 240°C and 300°C , while Littmann[30] employed Pd catalyst supported on a material of high surface activity at 260°-70°C High yields of *p*-cymene have been achieved

Thus, many of the dehydrogenation reactions discussed above fall within the generalization that on catalytic dehydrogenation, the breaking of the bi- and tri-cyclic systems of terpene hydrocarbons lead to the formation of unsaturated hydrocarbons, and in case these form an unsaturated hydroaromatic compound, complete dehydrogenation occurs , if the unsaturated hydrocarbon is a cyclopentane derivative, no further dehydrogenation takes place[16,24]

Catalysis — Consider the simple equation representing the disproportionation of terpenes into *p*-cymene $C_{10}H_{16} \rightarrow C_{10}H_{14} + H_2$ The reaction in the desired direction proceeds very slowly in the absence of catalysts Therefore, the performance of various catalysts have been studied

The catalysts may be summed up as " materials " which each by itself or mixed with one another split off free hydrogen while the terpenes are passed over them[11] Of these " materials " the most important are active C, salts of Mo, sulphates of Fe, Hg, Cu and Ca, sulphides of Ni, Co and Cu, oxides of Al, Co, Cr, Fe, Mn, Ni, Pt, Pd, Sn, V and Zn

Carriers like alumina, asbestos, burnt clay, active C, partially dehydrated gypsum, kieselguhr, pumice stone, TiO_2, SiO_2, etc , are used[31] The activity of the catalyst is sometimes considerably affected by the carrier[25,32] Thus in the case of Pd and Pt catalysts, the order of activity is metal on charcoal ⟶ metal on asbestos ⟶ metal as black[33], and metal on alumina or charcoal ⟶ metal on pumice[35]

Temperature — Temperature plays a very prominent rôle in the dehydrogenation reaction Theoretically there would be increasing facility to dehydrogenate terpenes to *p*-cymene as the temperature rises since it is an energy-consuming process , but the influence of the temperature is complex

It is observed that above 550°C (even at lower temperatures) the *p*-cymene stage is passed and complications arise due to the reactivity of the isopropyl chain and the fission of the C-C linkages with the formation of undesirable products like isoprene, propylene, methane, etc , aromatics like styrenes, cumene, toluene, benzene, etc , tarry residue and elementary carbon[1,21,23,34]

However, we cannot draw definite conclusions as to the lower limit of temperature for the dehydrogenation because the activity of the catalyst employed dictates to a large extent this physical factor This is clear from the catalyst temperatures Tables I and II for the dehydrogenation of *p*-menthane and dipentene respectively.

TABLE I - DEHYDROGENATION OF *p*-MENTHANE

	CATALYST	TEMPERATURE °C
1	Pt Al_2O_3[29]	240
2	Pd Al_2O_3[30]	260 70
3	Cr_2O_3 Al_2O_3[30]	400 65

TABLE II — DEHYDROGENATION OF DIPENTENE

	CATALYST	TEMPERATURE °C
1	Pd C or Al_2O_3[36]	275
2	Pd-C[37]	290 310
3	Cr_2O_3 with Cu[38] or Zn oxide on a carrier	425-500

The only generalization that can be arrived at in this connection is that the temperature of dehydrogenation must be such as to effect maximum aromatization to *p*-cymene by splitting off hydrogen selectively with minimum cleavage of C-C bonds once the *p*-cymene carbon framework is attained Depending upon the experimental conditions, the temperature employed in the production of *p*-cymene ranges from 175° to 550°C

Diluents — If the conditions are favourable, the hydrogen released during the course of the aromatization tends to complicate matters by hydrogenolysis[25,27,28] The formation of undesirable products thereby can be minimized by creating low hydrogen concentration in the reaction zone[25] One of the ways of accomplishing it is by administering diluents with the terpene hydrocarbon vapours to remove the hydrogen ejected, physically or chemically[25,39]

The nature and concentration of diluent exert profound influence on the direction of the dehydrogenation[25] Ipatieff *et al*[25] employed three types of diluents (a) hydrogen acceptors such as pentenes and benzene, (b) hydrogen donors such as methyl-cyclohexane and (c) " neutral acting diluents " such as n- and iso-pentane H_2, N_2, CO_2, SO_2, NH_3, air and cresol have been tried[14,19,38,40]

Some other factors affecting dehydrogenation are (a) hourly liquid space velocity[20,30,31,41], (b) pressure[11,27,42], (c) size of the catalyst[20] and (d) material of construction of the pyrolytic tube[37,43-47]

In Table III is given a summary of the various vapour-phase processes

TABLE III

HYDROCARBON	CATALYST	TEMPERATURE °C
Terpenes with carbon arrangement in the nucleus as of *p*-cymene or attain it by fission of the double ring contained in them	Materials which each by itself or mixed with one another split off free hydrogen[11]	
Oil of turpentine	Cu net[46]	400
Carenes	Cu turnings[47]	400
d limonene	Reduced Cu[38]	280 300
Terpenes or terpene contg substances	Active C[48]	Suitable temp.
Terpenes or terpene contg substances	Active C[49]	350 550
Oil of turpentine free from pinene and similar compounds	Active C[49]	High temp

TABLE III — *contd.*

HYDROCARBON	CATALYST	TEMPERATURE °C.
Terpenes or oil of turpentine	Salts of Mo, e g NH_4 molybdate, molybdic acid or sulphides, hydroxides or chlorides impregnated on silica gel pumice or active C[50]	High temp
Sulphate turpentine	Active C[50]	
Oil of turpentine	Sulphate of Cu, Fe or Hg[51]	175 250
Terpenes from spent residue of essences contg limonene pinene and cineole	Active C[52]	300
Pure carene	Silicic acid with one or more of the following metals, or their oxides of sulphides Ni, Co and Cu[53]	350 450
Monocyclic terpenes, e g dipentene	Pd on activated C or alumina[54]	275
Carenes	Partially dehydrated gypsum[19]	180 400
Oil of turpentine	Hydrated Cr oxide of Al_2O_3[54]	350
Dipentene	Activated Al_2O_3 impregnated with 1% Cr_2O_3[54]	425 480
Dipentene	Equi mol mixts of an oxide of Cr and an oxide of Cu, Sn or Zn[54]	375 475
p menthane	Cr_2O_3, Mo_2O_3 or V_2O_3 on activated alumina[54]	400 465
Monocyclic terpenes e g dipentene	Cr_2O_3 CrO_3 and mixtures of these with MnO_2 on carriers[55]	415 459
Monocyclic terpenes e g dipentene limonene terpinolene and terpinenes	Cr oxide, combination of Cr and Sn oxides best Carriers recommended are activated Al_2O_3 SiO_2 TiO_2, burnt clay kieselguhr[31]	425 525
Dipentene limonene terpinolene terpinenes	Cr_2O_3 with or without oxide of Cu and (or) Zn on a carrier, e g alumina, burnt clay, silica or kieselguhr[56]	425 500
Dipentene	Cr oxide together with an oxide from the group consisting of Fe, Co and Ni supported on activated Al_2O_3[41]	400 525
p menthane	Platinized alumina[30]	230
Monocyclic terpenes, e g dipentene	Pd on C[37]	290 310
Monocyclic terpenes *p*-menthane	Pd on activated alumina[30]	260 70
Mixture of 13% 1 methyl 4 isopropyl and 5% 1 methyl 2 isopropyl cyclohexane and 65% 1, 1, 2 3 and 10% 1 1 2, 5 tetramethylcyclohexane	Activated Al_2O_3 contg 5% Pt[58]	240
Carenes	Cr_2O_3 Al_2O_3 Ni Cu[30]	500
Carene	Ni[59]	
Carenes	Partially dehydrated gypsum V_2O_5, Pt gypsum[30]	500
Terpinolene	Alumina, Al_2O_3 SiO_2[61]	300 450
Terpineol	Partially dehydrated gypsum[61]	250 500
Carenes	Fe_2O_3 on partially dehydrated gypsum, silica partially dehydrated ferrous sulphate, and ZnO[19,22,60,61]	250 500

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REVIEWS

Alcohol — A Fuel for Internal Combustion Engines, by S J W Pleeth (Chapman & Hall Ltd , 37 Essex Street, London, W C 2), pp xv + 259 Price 28s net

THIS OUTSTANDING PUBLICATION ON ALCOHOL as a fuel for internal combustion engines is in our hands at a very opportune moment The Government of India have whole-heartedly committed themselves to the development of power alcohol as an alternative motor fuel in the country That the same should have been delayed by more than a decade, after giving the necessary fillip to the sugar industry in the year 1932, is itself very disappointing to all those who at the very outset had thought of the necessity of disposing of the large quantities of molasses in this only possible way Nevertheless, interested propaganda effectively checked the establishment of the power alcohol industry in the country during all this period As a consequence of this attitude of apathy on the part of the Government and ignorance on the part of the public, huge quantities of molasses were wasted

There have always been two schools of thought on the merits of using alcohol as a motor fuel Countries more fortunately placed with regard to the availability of oil deposits like the U S A and Holland have always showed a tendency to resist the introduction of an alternative motor fuel On the other hand countries which have always depended on outside sources of motor fuel supplies have taken keen interest in developing alternative fuels especially as the shortage of the motor fuel was acutely felt during the two world wars This book is a dispassionate argument for developing alcohol as such an alternative fuel since practically every country which can continuously have the necessary farm products grown internally will be able to work the scheme of power alcohol on a permanent basis without depending on outside assistance

The opening chapter of the book gives a brief but excellent review of the various energy resources of the world like coal, petroleum, wood benzol and alcohol It is rather significant that while the estimated coal reserves of about ten billion tons can last, at the present rate of consumption, for about sixty centuries, the oil reserves of about 50 000 million tons have not probably more than a century to last This makes the problem of finding out a perennial source of supply for motor spirit one of utmost importance and urgency The author's treatise proves the suitability of alcohol for this purpose

The value of the above work is considerably enhanced by the chapters giving general information on alcohol and other liquid fuels, the processes of manufacture, the description of the working of internal combustion engines, with special reference to the differences made by the characteristics of liquid fuels In the description of internal combustion engines, stress is laid on the practical figures of temperatures, compression ratios and other characteristics of power development within the engine Much of the adverse criticism on alcohol seems to be based on its relatively lower volatility compared with various gasolines This subject of fuel volatility has been dealt with in one chapter in detail and in a technical manner The subsequent two chapters are devoted to the subjects of knock rating and engine tests These subjects, which are highly technical in nature are presented in a lucid and understandable way so that even those who have only elementary notions may understand them

The suitability of alcohol as a racing and aviation fuel is discussed, supported by much experimental data

It is highly gratifying to note that we find in this book a clear description of the much-discussed characteristics of fuel for internal combustion engines, namely cylinder wear, corrosion and gum formation. In addition to these, there is the question of water tolerance in the case of alcohol A detailed discussion of the last-mentioned subject has been helpful in determining the stability of the blends of alcohol with gasoline.

In one of the concluding chapters, the author gives suggestions to modify the standards laid down by the British Standards Institution (B.S.S. 507-193) for the testing of alcohol and alcohol blends. This chapter is particularly useful for the Indian power alcohol scheme, as a correct and practical specification is one of our urgent needs

The author has also made a survey of the existing literature on the subject of alcoholic fuels and how these fuels are used in the different countries of the world The book concludes with a chapter on a suggested plan for the future The author has laid stress on two schemes One is to convert coal to liquid products by high and low temperature carbonizations, by hydrogenation and by Fischer synthesis The next is to utilize the farm products to manufacture alcohol The whole subject is highly thought-provoking and of utmost importance to our country At the end of the book twelve useful reference tables are appended Each chapter ends with a complete list of useful references

Everyone interested in the subject of power alcohol, and, in fact, in the great national economy that is implied in this scheme, cannot but welcome this very useful contribution to the existing literature on the subject It is very gratifying to note that in one volume we get a masterly survey of the subject made against a perspective which helps in understanding the problems involved. This book is heartily recommended to one and all, and it is hoped that it finds a place in every library, technical and otherwise

G G R

Chemistry of Insecticides, Fungicides & Herbicides, by Donald E H Frear, (D Van Nostrand Co Inc, New York), Second Edition, 1948, pp x + 417 Price 33*s*

FEW FIELDS OF SCIENCE HAVE WITNESSED in recent years such phenomenal development as the field of insecticides and fungicides and there can be no doubt that mankind has in its possession today some very effective weapons for combating pests of different types The search for still more effective instruments continues and, in the meantime, the discriminating economic entomologist or plant pathologist interested in practical application has to exercise considerable care in the selection of the most suitable weapon from the armoury For this purpose, a proper understanding of the chemistry of the wide variety of materials confronting him is essential The book under review provides the requisite *chemical* knowledge

The first edition of the present book appeared in 1942 and the second edition which has followed the first after an interregnum of six years is an admirable example of lucid presentation of what is admittedly a difficult subject The subject-matter of the first edition has been rearranged, revised and expanded in certain places In addition entirely new chapters have been written on " DDT, Hexachloro cyclohexane and Chlordane " and " Herbicides " The book has been divided into seven parts, viz Inorganic Insecticides, Synthetic Organic Insecticides, Natural Organic Insecticides, Fungicides, Spray Supplements and Residue Removal, Herbicides and Analytical Methods Despite the obvious discontinuity that would naturally arise in dealing with insecticides, fungicides and herbicides in a single volume, it must be conceded that the author has succeeded exceedingly well in presenting a coherent whole Each chapter is followed at the end by a list of references pertaining to the subject-matter presented in the chapter and some of these references are as recent as 1946

While it is invidious to point out the more attractive chapters, the reviewer found the chapters V, X and XI dealing respectively with " DDT, Hexachloro cyclohexane and Chlordane ", " Rotenone and Rotenoids " and " Miscellaneous Insecticides Derived from Plants " exceptionally good It is perhaps inevitable that such references to toxicity as have been made in the book should mainly be concerned with horticultural pests But it is to be hoped that in the future edition, the scope will be widened and relevant information on the toxicity of insecticides to stored product pests will also be provided.

The proof-reading would appear to have been done well, but attention may be drawn to some of the more important slips in this connection On page 59 the formula for DDT should read as $Cl_2C\,CH(C_6H_4Cl)_2$ instead of $Cl_3C\,CH(C_6H_5Cl)_2$ On page 116 the formula for β-methyl allyl chloride should read as $CH_2 = C(CH_3)CH_2Cl$ and not $CH = C(CH_3)CH_2Cl$. On page 150, reference is made to formulae E, F, G and H, but the formulae themselves do not carry these identifying letters On page 152, Pyrethrin II should read as Pyrethrin I and Pyrethrin III as Pyrethrin II The statement on page 92 that "addition takes place at camphene double bond with simultaneous isomerization to yield isobornyl thiocyanoacetate" is not clear in its present context and needs some rectification

The above corrections are not suggested in any spirit of criticism of what is admittedly a valuable book The printing and get-up of the book are excellent and the type is very pleasing to read

S K R

The Basis of Chemotherapy, by T S Work & E Work (Oliver & Boyd Ltd, London), 1948, pp xx + 435 Price 26*s*

THE BOOK IS A WELCOME ADDITION TO modern knowledge in a borderline field of study which is rapidly growing and is becoming a tangled mass of varied data, sometimes too complex for an ordinary research worker to comprehend The authors are to be congratulated on the commendable attempt they have made in presenting a readable review of the fundamental concepts and rationale of chemotherapy, which will undoubtedly be of service to workers in the field of pharmacy, pharmacology, biochemistry and therapeutics

The book is divided into seven chapters, with a prologue and an epilogue The first chapter gives an historical account of the evolution of chemotherapeutic remedies from folklore and tradition to modern antibiotics, traversing the various phases through which protozoal, spirochaetal and bacterial chemotherapeutic concepts arose and took shape Chapters II, III and IV then give an excellent account of the present state of knowledge of cellular metabolism, essential metabolites and their relation to growth factors and prosthetic groups, enzyme kinetics and their inhibition by drugs A careful perusal of these chapters indicate the wide outlook and breadth of vision of the authors and unfolds to the readers the basic mechanisms that might be involved in selective drug action between the host and the parasite The discovery of the antagonism between *p*-aminobenzoic acid and sulphanilamide provided the first real indication of a possible mode of action ofc hemotherapeutic agents and this subject is examined in detail in chapter V, together with other examples of drug antagonism in the fields of arsenical and heavy metal drugs The possibilities and limitations of metabolite analogues as drug antagonists have been fully discussed here The next chapter (chapter VI) deals with drug resistance and here the complex mechanisms likely to be involved, particularly in protozoa and bacteria, are clearly and comprehensively examined The specificity of the resistance phenomenon, the likely nutritional and metabolic changes in the parasite and association of other changes with development of drug resistance are all discussed with a critical analytical judgement which will give much food for thought to the research workers The last chapter deals with the relation of chemical structure to pharmacological activity Subjects dealt with here include the variation of activity with structure of surface-active agents, basic dyes and sulphonamides, relation between acid and base strength and electronic configuration and relation of structure to inhibition of isolated enzymes All through, there is evidence of a wide and wise selection of materials and examples which have been assembled with scholarly precision and accuracy

The book is provocative of thought in a field which is still far from being well defined However, the authors have marshalled all the known facts regarding the "biochemical basis" of chemotherapy and these might lead to the unravelling of the still unknown changes and reactions which at some future date will throw light on the "real and fundamental basis" of chemotherapy This will only be possible when the exact differences in the drug reactions between the host and the invading parasitic organisms will be more clearly known than at present In the epilogue the authors have remarked "In chemotherapy the transition state has been reached, theory has overtaken fact and has begun to shape the future" We agree with this view and feel that the time will not be long when many known gaps in our present knowledge would be filled and chemotherapy would emerge as an exact science

The list of references at the end of the book occupies nearly 50 pages and many research workers would consider this very helpful for cross references and more intensive study of the literature

B. MUKERJI

Wool Research at Torridon: Wool Research, Vol 4, CARDING, pp. v + 244, 1948, Vol 6, DRAWING & SPINNING, pp vii + 254, 1949 Price £ 1/1/- (Wool Industries Research Association, Torridon, Headingley, Leeds)

As an animal fibre of the highest importance in textile industry, wool has occupied a place of unsurpassed merit since time immemorial It was probably the first fibre to be woven into fabric by man and just as it protected him in the prehistoric times from the rigours of the climate, it serves very much the same purpose even today No change in the course of centuries seems to be noticeable in respect of the quality of the woven fabric The *Mahabharata* records the gift of a fine shawl to King Yudhisthir by the King of Pamirs at the time of the great Rajsuya Yagna Hand carding, spinning on the *charkha* wheel and handloom weaving of the bygone days produced a quality fabric which stood in good comparison with the modern mill-produced material Even today the same old methods give results which are not inferior to those obtained by the machines The *charkha* as well as the mechanical mule both may produce equally fine yarn

Where is then the need for research in the making of woollen fabrics in so far as the carding, drawing and spinning operations are concerned? Answer to such a query may be provided only by the consideration of the fact that infinitely higher production by machine to meet the demand of goods today the world over make the slow manual labour for the vast quantities necessary unthinkable and once the use of machinery with its possible mechanical drawbacks are admitted, a number of problems arise, first in understanding the performance of the machine and then in the introduction of improvement, both in the methods of study and the machinery itself Besides, a number of basic principles involved even in the hand operations previously employed which were formerly obscure, now offer a natural explanation in the light of the accumulated experience and new knowledge

In its thirty years of existence, therefore, the *Wool Industries Research Association* has endeavoured to study closely the various problems connected with wool from the fibre stage to the finished fabric and has laid the foundation of work which is of a lasting value Some of the most important mechanically operated units employed in the manufacture of woollen fabric are the carding, drawing and the spinning machines and the two volumes under notice describe experiments devoted to a study of their performance under a variety of conditions

Vol 4, on carding, in its eleven chapters, gives an account of the development of the carding engine followed by a description of its action and a discussion on the forces being exerted on the wire and on the fibre in the machine The opening power of the card and the distribution and movement of wool fibres has been then examined at some length Other important features dealt with are the variability in the performance of the carding machine and a consideration of the causes of fibre breaks in the action

A full discussion of the value of these researches would take much longer space than could be possibly devoted here, but a glance at the various tables and figures suffices to show the patient and painstaking nature of the work carried out over a period covering more than twenty-five years The large part played by the statistical analysis of the results obtained is at once apparent The short period and the period variables in the slubbing uniformity have been traced respectively to the random distribution of the fibres and the mechanical peculiarities, the latter being more amenable to control The net outcome of the work in this direction may be judged by a comparison of the production of the several carding machines at the mills in 1924 and in 1947 under conditions comparable, as far as possible, regarding the quality of the wool processed The 1947 figures are higher by 20 per cent while the result shown in 1947 by a machine installed at Torridon is still better by 10 per cent over the 1924 figures This is a noteworthy achievement

Vol 6, dealing with the drawing and spinning, following the carding operation (the intermediate stage of combing is to be treated in Vol 5 in the next publication), traces again the development of the process and considers the quality of sliver as regards its uniformity in relation to the doubling and the drafting usually employed The irregularities present in the rovings are again very similar to those mentioned before for the slubbings As the short period variations due to random fibre arrangement are predictable from the fibre fineness data, the excess is naturally attributed to the lack of fibre control in the drafting operation, giving rise to the drafting waves in the periodic diagram The factors influencing their amplitudes are the uneven fibre lengths and the corresponding settings of the rollers in the frames. As yet these have not been fully explained but there is no doubt they will yield to future investigations. An important conclusion of practical value is, however, drawn that as the rovings become finer, the amount of irregularity introduced on drafting increases rapidly

Extensive tests on the effect of humidity on the tops and drawings show that by the time the material is spun, the difference in the initial moisture regain decreases and tends to a constant value, at constant humidity, but due to hysterises a top at the higher regain descends to a constant value which is higher than the one with an initially lower regain Further, the spinning efficiency, judged by the levelness of the yarn and the number of breaks, is maintained best at a relative humidity between 65 and 70 per cent, though above 60 per cent humidity the fly waste increases Tops with a regain value 17-19 per cent are the most suitable for the above condition

In the two volumes published now, the W I R A has given an account of the work which will be looked upon by the textile students as a model contribution to the methods to be employed in a difficult field of investigation, where a large number of variable factors require a close consideration and control.

Nine more volumes which are to follow, will deal with other aspects of wool, namely the growth of wool on various types of sheep, the fibre characteristics, carbonization, scouring, weaving, felting, dyeing, finishing and general working under mill conditions The whole set will, therefore, make a comprehensive work which will be prized equally by the students, research workers, technicians and the industrialists as well interested in wool

B K V.

Elements of Aerodynamics of Supersonic Flows, by Antonio Ferri (The Macmillan Company, New York), 1949, pp x+434 Price $ 10 0

THE SUBJECT OF SUPERSONIC FLOWS HAS become one of great practical importance since the World War II, even though as a theoretical subject it has been of some interest earlier Therefore, the book under review, being the first of its kind, ought to be of great use and importance to any post-graduate student of aeronautical engineering and theoretical aerodynamics This fact is further justified in view of the fact that the author discusses both theoretical aspects and physical phenomena of supersonic flows

In the first chapter the author describes one-dimensional phenomenon of supersonic flows and shock waves after a brief treatment of the mathematical preliminaries The next eight chapters deal with the two-dimensional phenomena. Where mathematical theory becomes difficult, a graphical discussion is attempted Experimental results are also indicated Such important phenomena as shock waves, interaction and reflection of shock waves and expansion waves, and rotational flows are discussed In addition, the author discusses profiles, effusors and diffusors and also a method of calculating the physical quantities involved Mathematically, the theory of characteristics of partial differential equations is shown to play an important rôle The rest of the book is devoted to a parallel treatment of three-dimensional flows

The book is useful for research workers and is recommended as a valuable addition to libraries

A M.

Radio Engineering, by Dr E K Sandeman (Chapman & Hall Ltd, London W C 2), Vol II, 1949, pp xxii + 580 Price 40s net

THE PRESENT BOOK IS THE SECOND VOLUME under the head *Radio Engineering* by Dr Sandeman, now of the Ministry of Supply in the U K and formerly of the Engineering Division of the *B B C* The two volumes, according to the author's preface, originated from instructions written primarily for the maintenance engineers at the *B B C* transmitting stations, so that newcomers with no knowledge of radio technique could acquire familiarity with working principles in the shortest possible time Subsequently, it was extended so as to constitute a book of reference for experienced engineers too

The first volume consists of 16 chapters, i e fundamental principles, A C circuits, thermionic valves, amplifiers, oscillators, drive-equipment, modulation, different types of transmitters — their maintenance and operation, feeders, aerial-coupling circuits and aerials A review of this volume has already appeared in this Journal

The second volume consists of 22 chapters, an exhaustive bibliography, and a list of references and an index of 23 pages Some of the more important chapters in this volume are balanced and unbalanced circuits, interference and noise, radio receivers, measuring equipment, feed-back, network theory, filters, fourier analysis, complex quantities, etc A complete chapter of 20 pages is devoted to a comprehensive list of formulae which a radio engineer needs, including algebraic, trigonometric and electrical

A special feature of this book is the extensive bibliography classified under a vast number of categories, selected from well-known journals like *J I E E*, *Proc I R E*, *B S.T J*, *E.W & Wireless Engineer*, *Marconi Review* and *Electrical Communication* (from their inception up to middle of 1942) Thus, the bibliography is somewhat not quite up to date as it misses the past 7 years' literature — particularly the valuable war-time researches and post-war technical papers and reviews of war-time researches

Further, the book itself does not cover the following modern radio engineering topics as radar, television, studio technique, valve design and recording If the author deals with these topics in a later volume, then the whole field of radio engineering would have been adequately covered and would prove most useful for practising radio, radar and television engineers too

There is no work so far published which covers "radio engineering" at a level as these two volumes attempt to cover So far, the leading work on radio engineering in the English language is by Dr F E Terman (McGraw-Hill) which was first published in 1932 and its 3rd edition (1947) is now available While Dr Terman's work covered really a very vast field, including such topics as " " radar and television ", the treatment there is general, rather very terse, and not in great detail, usually formulae are given without proofs The chapter on " radio receivers " is very scantly treated by Dr. Terman, while Dr Sandeman's treatment is at a higher level and in addition, is clearer and more mathematical

One special feature of this book is that both the treatment and presentation have a practical bias, in the form of technical facts, designs or methods, formulae, etc New precision methods of designing complete circuits for (1) transmitters, (2) receivers, and (3) impedance matching devices (in lines) are given

A very thorough fundamental treatment of " feed-back ", and a practical treatment of the design of electric wave-filters is included Information on the following topics, which are usually skipped over in the usual orthodox text-books, is included R F resistance, inductance of straight wires, impedance characteristics of feeders, curves for finding the spectra of frequency modulated waves, etc

While books like *Radio Receiver Design* (2 volumes) by Dr K R Sturley (Chapman & Hall) and *The Technique of Radio Design* by Dr Zepler (Chapman & Hall) still stand supreme in so far as " radio receiver design " is concerned, Dr Sandeman's 2 volumes on general radio engineering form useful adjuncts to general radio engineering literature, especially to one connected with radio transmitters in any form — design, maintenance, operation, etc

The diagram, printing, paper and binding are quite good, while conforming to the authorized economy standards The price of 40*s* per volume may appear, at first sight, rather high, but considering that the price of *Radio Engineering* by Terman (1091 pages) is $ 7 00, 40*s* for a technical book of about 600 pages containing several charts and diagrams, in the light of the present-day book production costs in the U K, is not too much, especially remembering that the volume of sale of these highly technical and reference books may not be very high

The reviewer warmly recommends Dr. Sandeman's works to every radio engineer and student for reference or regular study It is to be hoped that Dr Sandeman soon brings out a third volume covering the topics which have been omitted in these two volumes and also publishes a supplement to the bibliography so as to bring it up to date

V V L R

Wire Drawing Diamond Dies — Their Manufacture & Use

C J ZAVERI
Hindustan Die Co, Surat

DIAMOND and tungsten carbide dies are used for drawing wires of ferrous and non-ferrous metals Tungsten carbide dies are particularly well suited for drawing wires of heavier thicknesses

Industrial Diamonds — Nearly 20 per cent of the world's industrial diamonds are used for wire drawing dies The white variety is soft and is unsuitable for dies The structure of diamonds is a factor demanding study and only those that satisfy specific requirements should be selected for the manufacture of diamond dies The following properties are important (1) laminary formation of thin layers (2) freedom from pin holes, cracks, fissures spots or foreign matter, and (3) hardness

Use of Diamonds in Drawing Dies — Diamonds of very good quality should be used to ensure long life of the dies The tonnage of material drawn through the die is large when quality diamonds are used and for this reason it is cheaper to use diamonds of the highest quality

Diamond dies should be used for drawing wires of 20 S W G or finer Their use for 16 S W G is not recommended as the cost of the dies required is prohibitive and experience has shown that diamond dies with large bores often crack

The weight of a diamond in carats must bear a certain relation to the diameter of the wire to be drawn A certain wall thickness must remain round the bore of the die to absorb the pressure developed while reducing the diameter of the wire An allowance in weight must be made for subsequent re-cutting and re-polishing after the die has been used for a considerable time and a change in the diameter becomes noticeable Such allowances, if made beforehand, permit the use of the same die for the next or third bigger size

Table I gives the data for diameter of wire to be drawn and the corresponding weight of diamonds to be used

TABLE I

S W G	Bore size, mm	Weight, carats
50 to 41	0 02540 to 0 11176	[illegible]
40 to 36	0 11176 to 0 19304	[illegible]
35 to 34	0 19304 to 0 23368	[illegible]
33 to 31	0 23368 to 0 29464	[illegible]
30 to 27	0 29464 to 0 41636	1
26 to 25	0 41636 to 0 5080	1½
24 to 23	0 5080 to 0 6096	2
22 to 21	0 6096 to 0 8122	2½
21 to 20	0 8122 to 0 9144	3

Care of Dies — The factors which determine the life of a die are

(1) the quality of the diamond

(2) the size of the diamond and its mounting in the case,

(3) the shape of the bore and the reduction given to the wire,

(4) the quality of the bore polish, and

(5) drawing lubricant

1 The best diamonds are the cheapest in the long run

2 *The Size of the Diamonds* — (i) A diamond of sufficient weight and size should be chosen to guard against cracking and to permit future re-cutting and re-polishing (ii) The diamond must be mounted in a strong case of suitable size so that it may not move or expand during the drawing operation The process of mounting in use are In the ordinary process the diamond is fixed in a brass case and the opening is closed with copper or bronze by brazing, in the special process, the diamond is first cut to give a round disc and then

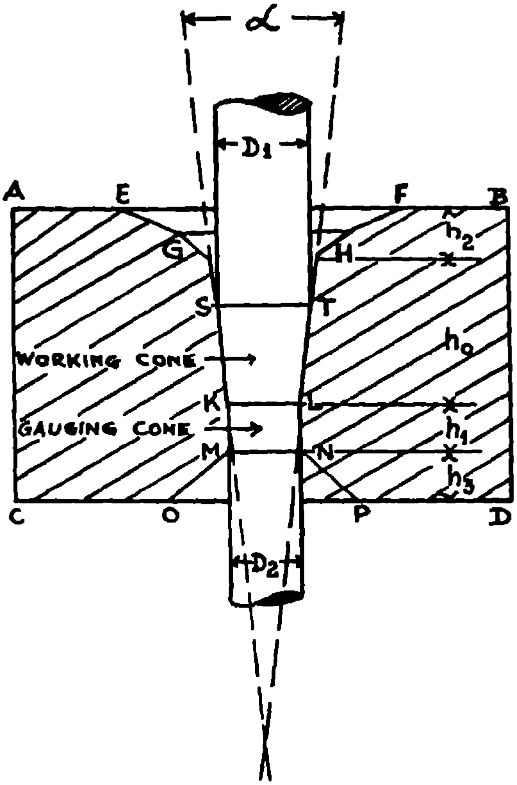


FIG 1

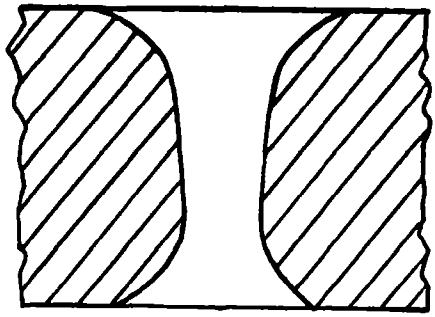


FIG 2

fitted in a steel ring in which a corresponding recess has been made and then brazed solid with copper or bronze This steel ring is then fixed in a brass outer case and brazed

This second process gives added strength to the diamonds and for economy diamonds of even smaller sizes than those specified can be used thus reducing the capital investment Dies made by this process are least likely to crack , the brass case must be strong enough to take all the forces resulting from the drawing operation, i e the axial forces exerted in the drawing and representing the drawing pull as well as those vertical to that direction representing the pressure upon the walls of the drawing cone, the pressure which tends to burst the diamond

3 *The Shape of the Bore of the Diamond* - Fig 1 shows the different parts of the bore of a diamond and Fig 2 illustrates the same bore when polished ready for drawing

All the dimensions of a diamond are definitely related to the bore size The outside diameter of the diamond should be equal to about eight times its bore and the thickness of the diamond about six times its bore The total length of the drawing cone should be between half and full diameter of the bore and the length of the gauging cone the lubricating cone and the exit cone should be half the diameter of the bore

The angle of the drawing cone varies with the quality of the material to be drawn, with the reduction in diameter of the wire sought and the lubricant used

A general rule takes the drawing cone angle as

(a) Hard material, e g steel	10°-15°
(b) Medium hard material, e g iron , copper bronze	15°-20°
(c) Soft materials like aluminium	20°-25°

This angle of the drawing cone is the most important part of the bore in the diamond die As a matter of fact, incorrect angle results in unsatisfactory work both as regards the surface and dimension of the wire, at the same time reducing the life of the die

Figs 3 and 4 show the difference of the working surface ABCD and EFGH when drawing wire with the same reduction from diameter D_1 to D_2 with an angle of 10° and 20°

Since the reduction in both cases is the same, the total pressure in the bore of the die will be the same, but the specific pressure, i e the pressure per sq in exerted through the wire upon the surface of the drawing cone will be greater for the larger angle (20°) because the surface of the cone EFGH is smaller than that of the cone ABCD On the other hand, one cannot choose too small an angle for a given reduction of wire as the friction between the wire and the cone increases in relation to the diminution of the angle This friction can increase to an extent that the required force for pulling the wire through the die becomes greater than the " yield point " of the wire, and this results in breaking the wire

4 *The Quality of the Polish of the Bore of a Diamond* — The quality of the polish of the bore has a great influence upon the life of the dies

Considering Fig 2, the theoretical form shown in Fig 1 takes the form of Fig 2

The finish of the polish of the bore must be given with diamond powder of at least 400 mesh This polish is obtained on special polishing machines by means of diamond powder suspended in oil

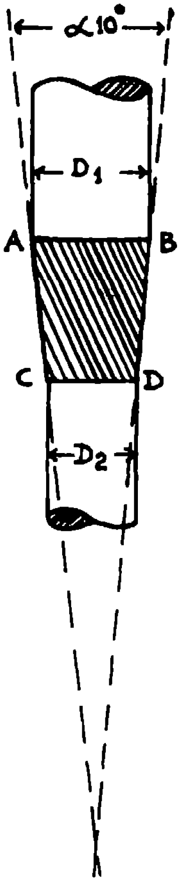


FIG 3 — LENGTH OF DRAWING CONE WHEN DRAWING FROM D_1 TO D_2 WITH A CONE OF $\alpha = 10^\circ$

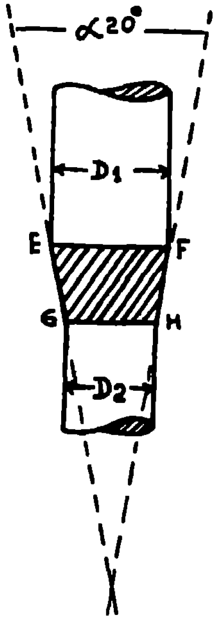


FIG 4 — LENGTH OF DRAWING CONE WHEN DRAWING FROM D_1 TO D_2 WITH A CONE OF $\alpha = 20^\circ$

Dies should be inspected after each run, and as soon as the polish shows the faintest sign of attack, the die should be re-polished

All wires pickled and annealed should be thoroughly cleaned and freed from loose scale and acid as they attack the polish

5 *The Drawing Lubricant* — Thick and hard wire is drawn with powdered soap, rape oil or tallow Finer wire is drawn in cold soap water and this should remain cold during the drawing operation The drawing lubricant must be kept scrupulously clean

Scientific & Industrial Research in Australia

CONSEQUENT upon the enactment of the Science & Industry Research Act in May 1949, the Commonwealth Scientific & Industrial Research Organization took the place of the 22-year old Australian Council for Scientific & Industrial Research The powers and functions of the Organization are similar to those of the Council and include "the initiation and carrying out of research in connection with, or for the promotion of, primary and secondary industries in the Commonwealth or any Territory of the Commonwealth, or in connection with any matter referred to the Organization by the Minister, the training of research workers, the making of grants in aid of pure scientific research, the testing and standardization of scientific apparatus and instruments, and the carrying out of scientific investigations connected with standardization, the collection and dissemination of information relating to scientific and technical matters the publication of scientific and technical reports and periodicals, and acting as a means of liaison with other countries in matters of scientific research" The Governing Body of the Organization consists of an executive of five persons which will be assisted by an Advisory Council constituted precisely on the same lines as the former body

The work of the Organization is reviewed under 30 heads in the Annual Report A few of the more important research projects undertaken and completed are given below

The Soils Division has developed improved spectrochemical methods of quantitative analysis and routine determination of the minor metallic components of soils and plant samples

Studies on the soil moisture régime of two contrasting soil types and relations established between application infiltration, and soil moisture indicate that it should be possible to define the irrigation requirements of a soil from a knowledge of its infiltration characteristics and the soil-moisture status

Experiments on eradication of weeds have revealed that power kerosene gives a rapid kill of top growth Among the new weed killers ammonium trichloracetate at 100-200 lb/acre has given excellent results on couch grass This compound acts as a temporary soil sterilant and was most effective when applied to moist soil Chloropicrin and DDT have been found effective for the control of nut grass in tobacco-growing areas Investigations on *guar* (*Cyamopsis tetragonoloba*) have indicated its utility as a forage plant and as a source of mucilage for use in the paper and food industries Improved types of opium poppy have been evolved to yield 50 per cent more opium per acre than the variety grown previously A method for separating mixtures of hyoscine and hyoscyamine by a partition chromatogram on a buffered column of kieselguhr promises to be useful

It has been established that the yellow dwarf virus of tobacco has a wide host range a factor which will be of immense help in devising methods of control Growth studies of many varieties have been conducted and the ***Pusa type*** 142 and ***Mustaphabad*** both from India, were outstanding for width and number of leaves respectively Physiological investigations on tobacco were concerned with the growth and development of the tobacco plant when grown at different levels of soil moisture and subjected to varying drought treatments The reactions of 4 growth-regulating compounds on the development of axillary growth (suckers) indicated the possibility of the axillary growth being inhibited

A modified technique for the identification of leaf roll-infected potato plants has been developed This test is being used to measure the leaf-roll resistance of potato hybrids

The behaviour of rubber plants under varying conditions of growth, as governed by climatic conditions and intermittent water supply both under natural rainfall and in irrigated areas, has been studied

The activities of the Animal Health and Production Division have been concerned mainly with problems relating to sheep and cattle industries Studies on the nutritional physiology of the sheep and its relations to wool production have shown that the rate of wool growth is determined by the quantity and quality of the protein available from the ration and the intake of other dietary constituents to meet the energy demands Chronic ingestion of moderate amounts of molybdenum precipitates more rapidly the untoward effects of copper deficiency in sheep fed on copper-deficient pastures The relatively large amount of energy that is dissipated without performing any useful work in the animal has been proved to be directly proportional to the intake of fodder and to vary with the type of fodder These findings may be of importance for a rational approach to draught feeding

Anaerobic destruction of ascorbic acid in canned fruit and vegetable was investigated in the Food Division. In various buffers, varying from *p*H 2·2 to 7·0, but with no other added substances, maximum rate of destruction was observed at *p*H 4. As higher rates of destruction occurred in fruit and vegetable extracts, it became apparent that some substances could exert an accelerating effect. A large number of substances were tested, and definite effects have been observed with fructose, sucrose and hydroxymethylfurfural.

Preliminary work on the canning of bananas indicates the necessity for processing in water at 212°F and the need for acidification of the syrup to permit this procedure. A product attractive in appearance and texture but slightly acid in flavour has been prepared.

The work on wood chemistry included methanol extraction of lignin, study of aldehydes isolated from eucalypt lignins, wood carbohydrates, wood hydrolysis, and pulp and paper investigations. Urea formaldehyde and melamine-formaldehyde resins have been employed for increasing the wet strength of paper. The work has revealed that eucalypt pulps are not as amenable to wet strength development by means of resins as are long-fibred pulps.

Work on architectural acoustics formed an important part of the investigations in the Building Division. Tests to determine the probable life of building materials under natural conditions of exposure have been developed. Research on concrete roofing tiles has resulted in the development of a new spraying device for applying a mortar finish which is expected to improve the appearance and durability of the product. Investigations into the preparation, properties and uses of foamed concrete, and a fundamental study of air entrainment have been continued. Resinate compounds, alkali derivatives of sulphated fatty alcohols, and certain sodium alkyl-aryl sulphates stabilized with sodium carboxymethyl cellulose and hydrolysed animal glue (with or without the addition of aluminium sulphate), have been found suitable as foam-forming agents.

Work on the structure of the wool protein (keratin) and other related fibrous protein systems has proceeded along 3 main lines: electron microscopy, X-ray crystallography and infra-red spectroscopy. Studies on muscle and tendon, using electron microscopy, have provided new data on cellular organization and on the distribution of inorganic constituents along these protein fibres.

Researches on mineral utilization, ceramics and refractories, organic chemicals and wool formed the main lines of work in the Industrial Chemistry Division. The nature of the surfaces of mineral particles after certain ore dressing operations is of prime importance in their flotation, and the properties of metal surfaces in bearings and cylinders determine their efficiency and wear. A mathematical theory of the stability of the polished layer formed on some metals has been developed and has been confirmed by preliminary experimental observations using electron diffraction methods. Automatic equipment has been developed for use with the mass spectrometer for the precise measurement of bond dissociation and ionization energies in volatile compounds.

The work of the Organic Chemistry Section has been chiefly directed to the recovery and purification of waxes of potential industrial importance, particularly those recoverable from wool.

During the year, work has continued on the establishment of a laboratory in the Chemical Engineering Department, University of Sydney, for the determination of the physical properties and behaviour of pure compounds of binary and ternary mixtures at high pressures. Work is nof progress on the development of a new method separation based on selective adsorption which is being developed with a view to developing a continuous industrial process for the separation of chemically similar materials not readily separated by current industrial methods. The behaviour of fine solid particles suspended in gas or liquid media which is being investigated with a view to correlating such diverse industrial operations as dust and fume removal, sedimentation, filtration, thickening and pneumatic conveying.

A four stage process for selective soap flotation of zircon from rutile, ilmenite and quartz has been developed and details of this process have been published.

Researches carried out in the Physical Metallurgy Division have shown that titanium is surprisingly ductile, and that its tensile strength could be raised from 30 to 90 tons/sq in by continued fabrication at room temperature. In studying the allotropic change of titanium and its alloys a new technique has been developed which is likely to have a wide application in the study of phase transformations in alloys. The method consists of determining the hydrogen pressure at different temperatures when a very small amount, some 0·001 atomic per cent, is dissolved in the metal.

Work on the nature of metallic friction at the Division of Tribophysics has indicated that sliding metal parts are deformed for a considerable depth below the surface of contact. A new electrical device has been developed for the work on piston ring lubrication which permits the simultaneous study of piston cylinder contacts and pressure inside the cylinder.

A number of sensitive temperature controlling instruments have been built for use in the experiments on diffusion and specific heat.

The Division of Metrology has developed a new method of calibrating angle standards by interferometry. A Kosters type interferometer is being designed for measurements up to 300 mm.

Measurement of steps in glass surface finish standards by the use of multiple beam Fizeau interference fringes in transmission is showing high promise. The order of precision obtained by this method is 10 Å (0·001 micron).

Work has continued on the production of standards of surface finish used for the calibration of instruments for measuring surface finish. The best standards overseas consist of grooves etched in glass after cutting through a resist. Improved grooves were obtained by employing an undercoat of metal under the wax resist. The newer method developed in the Division has proved quite successful. The wax resist is placed on slip gauge surface and after a series of rulings have been cut from the wax, chromium is deposited on the exposed surface of the slip gauge. The exposed surfaces of the deposited metal are then lapped parallel to the under surface by a technique developed in the Division This work on surface finish standards has led to the development of an interesting method for the production of graticules in conjunction with the Radiophysics Vacuum Laboratory

A technique of calibrating thermocouples at the freezing point of various metals has been simplified by using a D C galvanometer amplifier combined with automatic recording devices A report on psychrometry has been prepared which includes the results of the work on the effect of air speed and element size on the temperature depression of a wet element and describes various types of thermocouple psychrometers to meet general and special requirements of humidity measurement

The Physics Division has been responsible for some important researches in solar physics A theory of chromospheric flares developed in this section attributes these flares to electric fields resulting from the changing magnetic field of sunspots This has led to studies of the excitation conditions of the hydrogen atmosphere of the sun and to the study of further problems concerning solar phenomena

A new method of compensating a sub standard instrument for temperature changes has been worked out in the Electro technology Division

A satisfactory design of oil filled bushing has been developed for use in compressed gas capacitor rated at 132 kV

The Division of Radio Physics has made significant advances in radio astronomy and especially in the fields of solar noise stellar radiation and galactic noise Studies on radio echoes from the moon revealed that a controllable signal which passes through the ionosphere and returns by the same path provides a means of investigating conditions in the highest regions of the earth s atmosphere

A number of radar aids have been perfected during the year Among them are the distance measuring equipment (D M E) which provides the pilot with a direct indication in miles of his distance from beacons at known points on the ground the multiple track range for providing tracks radiating from an airport by means of which a pilot can guide the aircraft along any one of the selected tracks the airways control radar designed to allow a traffic control officer to fix the positions of aircraft within 100 miles of his airport

Kinematic and dynamic studies conducted in the Meteorological Physics Section on the wind structure in depressions and anti cyclones have led to the conclusion that the motion of these systems is greatly affected by the horizontal wind distribution and dominated by the thermal distribution over the regions of strongest winds and not as previously supposed over the centre Studies on the physics of rain formation have revealed that raindrops begin their life as snow or ice particles as postulated by Bergeron on perhaps half the occasions For the other half of the time rain appears to form without ice being present Owing to the great scientific and practical importance of the fact that rain can fall from clouds that do not reach the freezing level an intensive study is being made of these occasions and it is hoped shortly to have an understanding of the mechanism Measurements are being made by radar observation of the raindrops within these clouds These are supplemented by direct observation of the size of raindrops at different levels above the ground made by means of a balloon borne microphone which transmits back to the ground by radio a signal proportional to the momentum of the drops Experiments are also made in which drops of a given size are introduced at known positions in particular clouds and careful observations made of their subsequent history

A powerful experimental method of investigating the artificial stimulation of rainfall by the dry ice process has been developed using a downward looking radar set in an aircraft which remains above the seeded cloud during the whole of the experiment Echoes are received from the snow ice and raindrops produced in the cloud estimates can be made of their size and their growth can be traced as they descend through the cloud As a result of this work a reasonable prediction can be made of the effect of dry ice on any given cloud of the time likely to elapse before rain appears from the base and of the probability of its reaching the ground

A million volt electrostatic generator has been installed in the Atomic Physics Division and methods of controlling the potential to 0 2 per cent between 300 and 800 kV and to 0 5 per cent above 800 kV has been developed Electronic devices have been designed for stabilizing the potential applied to the accelerating tube and the current which energizes the electromagnet that resolves the ion beam

An apparatus has been constructed for magnetically sorting out positive and negative mesons and determining their decay times

Standardized methods and equipment for the assay of radioactive elements commonly employed in tracer technique have been developed Radio manganese has been employed to study manganese molybdenum antagonism in plants

A Section of Mathematical Instruments was set up as a separate unit in the Electro technology Department The Section has developed useful instruments such as the course plotter designed to plot automatically and continuously the course of a vehicle in which it is mounted and fitted with a gyro stabilized magnetic compass unit

In addition to the existing *Australian Journal of Scientific Research* published by the Organization in collaboration with the Australian National Research Council the Organization is establishing two new journals the *Australian Journal of Applied Science* and in collaboration with the Australian Institute of Agriculture Science and the Australian Veterinary Association the *Australian Journal of Agricultural Research*

During the year the Information Service officers have prepared 250 *abstracts* covering material of chemical interest appearing in Australian periodicals

NOTES & NEWS

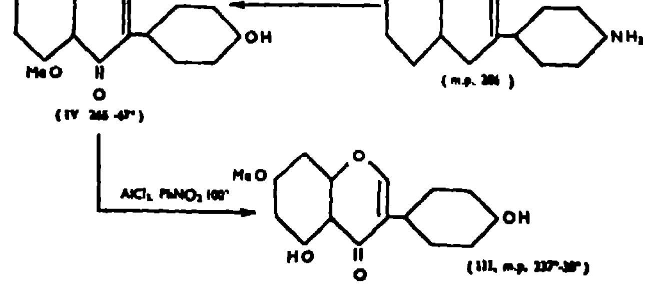
Synthesis of Prunetin

AN ELEGANT METHOD FOR THE synthesis of the *iso*flavone, prunetin, has been described (*Curr Sci*, 1949, **78, 404**)

The action of ethyl orthoformate on 2-hydroxy-4 6-dimethoxyphenyl 4-nitrobenzyl ketone (I) in boiling pyridine containing a little piperidine yields 5 7-dimethoxy-4′-nitro*iso*flavone (II) in 60 per cent yield Prunetin (III) has been synthesized from (I) by the series of reactions indicated below

Preferential demethylation of the 5-methoxyl group in (IV) can be effected by means of aluminium chloride in nitrobenzene or hydrobromic acid in acetic acid Such partial demethylation of the 5 and 3-methoxyl groups in the flavone series so far used for the synthesis of several naturally occurring, partially *O*-methylated flavones and flavonols has now proved to be of value also in the *iso*flavone group The *iso*flavone (IV), a suitable intermediate for santal, has recently been shown to be 5 3′ 4′-trihydroxymethoxy-*iso*flavone

The naturally occurring *iso*flavones, daidzein and *pseudo* baptegenin, have been synthesized 2-hydroxy-4 6-demethoxy phenylbenzyl ketene (m p 116°C) condenses readily with ethyl formate and sodium to 5 7-dimethoxy*iso*flavone (m p 120°C) and demethylation with hydriodic acid gives 5 7-dihydroxy*iso*flavone m p 193° 94° partial demethylation with hydrobromic acid in acetic anhydride gives 5 hydroxy-7-methoxy*iso*flavone m p 139°-40°C



Electrophoresis by the Moving Boundary Method

THE THEORETICAL AND EXPERIMENTAL aspects of the moving boundary method for the determination of the mobilities of crystalloidal ions and colloids are presented in an excellent monograph by H Svensson (*Mineralogi och Geologi* Band **22A,** No 10, Arkiv for *Kemi* Sweden) Summarizing the existing literature on the various sources of error in the method the author has quantitatively formulated a general theory of electrophoretic migration to account for the boundary anomalies Detailed directions are given for the working of the author's improved form of Tiselius electrophoretic apparatus An elementary theory of the crossed slit method of observing the boundary is given and the sources of error in the method analysed The use of concave mirrors instead of lenses is described and the advantages and disadvantages of this method pointed out A new method based on combined electrophoresis and conductivity measurements on solutions in Donnan equilibrium has been adopted for measuring the charge on colloids The mobility measurements are carried out on serum proteins and haemocyanin, which indicate that the affinity of proteins for diffusible ions increases with the size of the latter The chapter on electrophoretic analysis contains further evidence regarding the reliability of electrophoretic analyses, if carried out carefully The data also show that mobility is a fairly stable property and does not greatly change during a drastic fractionation procedure The final chapter deals with preparative electrophoresis wherein an apparatus with a new sampling device has been described and its advantages pointed out

This highly useful monograph should undoubtedly find a place in every advanced physico-chemical library

K S GURURAJA DOSS

Weed Eradication by Synthetic Hormones

THE GOVERNMENT OF BOMBAY are conducting investigations on the weed-killing properties of new synthetic hormones (*Proc Indian Acad Sci* 1949, **30, 244**)

The following 4 preparations were tried (1) methoxone or agroxone containing 10 per cent sodium-4-chloro-2-methyl phenoxyacetate as the active principle, (2) fernoxine containing 80 per cent of the sodium salt of 2, 4-dichlorophenoxyacetic acid (3) weed no-more containing 40 per cent of the ethyl ester of 2, 4-dichlorophenoxyacetic acid, and (4) weedone containing 10 per cent of an unstated compound of 2 4-dichlorophenoxyacetic acid

The compositions were first used in very low concentrations of 1 to 10 parts per million to stimulate the growth of plants Higher concentrations of 100 to 1,000 parts per million resulted in over stimulation and a short period of rapid abnormal growth followed later by death of certain plants All grasses and cereals like wheat, barley, rice, *sorghum* and maize are not affected Linseed, strawberries, tea and coffee plants are likewise resistant.

These weedicides can, therefore, be used with the crops mentioned above for eradicating a number of weeds without fear of harming the crops. On the other hand, crops like cotton, tobacco, tomato, sweet-potato, brinjal, chillies and all legumes are extremely susceptible As a result of tests which have been carried out on both actively growing and mature herbaceous weeds of each of the species mentioned, it has been possible to classify the weeds into three classes, viz (1) susceptible, i e. those which succumb to applications of ½ to 1 lb per acre, (2) intermediate, i e those which require applications of at least 2 lb per acre for obtaining a kill, and (3) resistant, i e those which show no signs of injury or recover in spite of injury even when treated at the rate of 2 lb per acre The degree of susceptibility of common weeds, their response and the end results of spraying with these hormones have been tabulated The response of plants is conditioned by several factors of which the stage of growth of the plants and the prevailing temperature are most important. No particular difference in the effectiveness of the different preparations used has been noticed

Studies are being made on the control of *Cyperus rotundus* (*Lavada*) and *Striga* sp which are considered to be the two very serious pests in the Bombay province Preliminary observations indicate that the use of the new insecticides will afford an effective method of controlling *Cyperus rotundus* in crops like wheat and *sorghum* Both species of *Striga S lutea* and *S densiflora* have also responded very quickly to the application of 0 1 per cent of these weedicides which kill not only above-the-ground parts of *striga* plants but the underground seedlings as well up to a depth of 6 in in about 6 days

Striga attack on *sorghum* is a serious problem in the provinces, of Bombay, Central Provinces and Madras and it is quite likely that the use of these weedicides may effectively solve this problem

Stimulation of Sugarcane Cuttings

ARTIFICIAL STIMULATION OF sugarcane stem cuttings by immersion in hot water (52°C) for 20 min results in rapid development of all lateral buds and precocious growth of young cane stools (*J agri Res*, 1949, 77, 223)

Growth observations were made on plants grown in a disease and insect-free greenhouse Canes detatched for treatment were severed from the stool at, or slightly below, the soil level Hot-water treatment by immersion in baths at 52°C for 20 min was applied to stems segmented in various ways and to entire stems. After treatment the seed cane was planted horizontally, with the buds at the side By means of specially designed jackets, hot-water treatments were applied to portions of stems that were still attached to the growing stools of the cane

The treatment stimulates the development of lateral buds on entire stems and on multiple-bud, two-bud and one-bud cuttings It is multiplied in one-bud cuttings by application of an auxin to the basal cut surfaces In entire stems and multiple bud pieces, apical dominance is greatly reduced after heat treatment, resulting in development of many more shoots than on untreated controls Shoots developing from buds located below the axis of a horizontally placed untreated cutting grow out much more slowly than shoots developing from buds located at the sides or above the axis of such a cutting In heat-treated cuttings, however, this position effect is considerably diminished, lower buds growing out much more rapidly In horizontally placed top cuttings, the normal geotropic reaction due to cell elongation in the lower parts of growth rings is suppressed by the hot-water treatment

Auxin analysis of the nodes of sugarcane cuttings immersed for 20 min in hot (50°C) water in comparison with nodes of control cuttings immersed for 20 min in tap water at room temperature (26°C) revealed a decrease, sometimes amounting to 50 per cent or more, in the apparent free-auxin level of the material treated with hot water Such decrease appeared to a slight extent only when tests were made immediately after the hot-water treatment, it developed gradually Considerable indirect and direct evidence is at hand indicating that the promotion of bud growth by hot-water treatment and a lowering of the auxin are correlated

Ascospores from Bakers' Yeast

A NEW METHOD FOR OBTAINING ascospores from bakers' yeast cultures is recommended involving the direct transfer of vegetative cells from a solid nutrient medium to a solid medium containing an acetate The method is particularly useful in the preparation of ascospores for instructional work and for generic research in yeast and may also find application in yeast taxonomy (*Canadian J Res*, 1949, 27, 179)

The following modifications of the Stantial Elder method for producing ascospores were found to give better results (a) vegetative cells may be multiplied on a solid nutrient medium instead of in a liquid medium, thus obviating filtration to free the cells from the culture medium, (b) the liquid sporulation medium may be replaced by a solid medium prepared by adding 2 per cent agar to a medium consisting of 0·04 per cent dextrose and 0·14 per cent anhydrous sodium acetate in distilled water When this medium is used, the cells may be transferred directly to sporulation medium from the solid nutrient medium without involving the numerical estimation and adjustment of cell suspensions and (c) when liquid sporulation medium is employed, the concentration of cell suspensions may be adjusted by comparison with permanent density standards prepared and employed as in the estimation of bacterial cell numbers by the McFarland nephlometer technique This method of estimating cell concentrations was found to be much more rapid than the haemocytometer method employed by Stantial and Elder The yields show that these modifications give yields quite comparable to those obtained with the Stantial Elder technique The addition of a trace of peptone to the solid sporulation medium gave the highest yields The following 5 types of media employed to multiply the vegetative cells had no appreciable effect upon the yield of ascospores (1) dextrose nutrient agar, prepared by adding 2 per cent agar to a consistency of 5 per cent dextrose in Difco nutrient broth (0 5 per cent tartaric acid added to inhibit bacterial contamination), (2) grape juice agar — juice of freshly crushed red grapes filtered and diluted to 5 per cent sugar content and containing 2 to 2 5 per cent agar (3) tomato juice agar — 2 per cent agar added to commercial canned tomato juice (salted) filtered and clarified

Experiments on the ability of various acetates to induce ascospore formation in sugar free liquid medium showed that best results are obtained with sodium acetate The depth of the medium was found to affect the ascospore formation High yield was obtained from tubes (16 mm × 150 mm) in which the depth of medium was 9 mm or less

Oxidation of Aldehydes

THE OXIDATION OF ACETALDEHYDE by oxygen to acetic acid can only be carried out safely on a large scale if salts of heavy metals are added to prevent the building up of explosive peroxide compounds Experiments were carried out to determine the true rôle of manganese salts which are widely used for this purpose

These experiments showed that the speed of reaction was dependent on the manganese concentration At low concentrations the speed was lower than that of the manganese free reaction whilst with increasing concentration the speed rises to a maximum about one third greater than that of the catalyst free reaction

A definite induction period was noted which also increased with the higher manganese concentrations Under certain conditions the change of the manganese (II) to the dark brown manganese (III) condition can be observed

The sequence of effect is

(1) Formation of a peroxide from aldehyde and oxygen

(2) In the absence of catalysts the peroxide gives the impulse to the chain reaction of aldehyde oxidation with molecular oxygen The manganese (II) salt however captures the peroxide and a change to manganese (III) salt occurs The chain reaction is thus held up and the induction period appears

(3) The manganese (III) salt likewise decomposes the peroxide and transfers the oxygen to the aldehyde (*Angewandte Chemie* Aug 1949 318)

Evaluation of Anti-fungicidal Chemicals

AN IDEAL FUNGICIDE IS ONE which is non irritating has a low sensitization index suppresses the growth of the fungi and which at the interphase between fungicidal and fungistatic activity does not stimulate the pathogenic organisms to produce antigens Well established procedures for evaluating all except the last factor are known A method for evaluating this factor is described (*Trans New York Acad Sci* 1949 2 113)

The method is based on the study of the effects of addition of fungicides on the production of trichophytin the water soluble antigen found in the pellicle and the filtrate of a culture of fungus on Sabouraud s bouillon which are elaborated by fungi in the course of infection Trichophytin has been identified with the specific sensitizing factors The existence of a relationship between the changes in the *p*H of Sabouraud s bouillon and the appearance and the concentration of the skin test factor (trichophytin) has been established

The specimens are tested for their trichophytin content by the usual intradermal trichophytin technique It is usual to grade the reactions from 1 to 4 plus Iodine sodium benzoate sodium undecylinate sodium propionate and sodium caprylate boric acid penicillin G and penicillin have been evaluated employing this method

Gas Analyses in Sulphuric Acid Manufacture

A SEARCH HAS BEEN MADE IN Czechoslovakia for a rapid and reliable method of analysing gaseous mixtures before and after passing over the catalyst in the manufacture of sulphuric acid by the contact process The standard apparatus of Reich is found adequate for the determination of sulphur dioxide in pyrites gases and others before reaching the catalyst The same apparatus cannot however be used to analyse the resultant gases after they have passed over the catalyst since sulphur trioxide attacks the rubber connections

A new simple apparatus with glass joints has been devised for collecting the gases from the reaction chamber The gases are drawn in through a drechsel bottle containing sulphuric acid which removes the sulphur trioxide whilst the rest of the gas under reduced pressure passes into a globe in which the sulphur dioxide is absorbed and titrated with centinormal iodine solution Only 10 ml of sulphuric acid are needed (older methods required 2 litres) and a nomogram has been constructed to permit the degree of oxidation to sulphur trioxide in the final product between 90 and 99 per cent to be read directly (*Industrial Chemist* Dec 1949 p 578)

New Chromate Pigment

A NEW CHROMATE PIGMENT (barium potassuim chromate) known under the trade name *Pigment F* is being produced on a pilot plant scale (*Chem Trade J* 1949 125 637) This compound has a low water solubility and yields 20 to 25 per cent more chromation per unit weight than the other soluble chromate pigments

The pigment is produced by reacting potassium bichromate and barium carbonate at high temperature The bichromate obtained as fine crystalline mass is pulverized in a high speed hammer type Mikro mill fitted with a 0 0625 in screen Blending is effected in a combination ribbon and paddle type blender Yields over 99 per cent of the theoretical are obtained

The kiln is heated by an open propane jet The reactants are fed at a rate of about 300 lb per hour and require about an hour to pass through to the discharge end The finished pigment discharged from the kiln is obtained in yellow to greenish yellow nodules varying from 0 125 to 0 5 in in diameter

The pigment has been found to be compatible and stable with almost all paint vehicles and pigments now in commercial use Its exceptionally low reactivity towards the vehicle acids is responsible for the excellent storage stability of proprietory paints formulated

Sulphuric Acid Manufacture by Gaillard Process

A NEW PLANT EMPLOYING THE Gaillard process for the manufacture of sulphuric acid is in operation in France at Issoudun and Voves (*Chem Trade J* 1949 125, 639)

The plant wherein a number of improvements have been effected gives an increased production per cubic meter of chamber space The chief feature of the Gaillard process is the cooling of the lead chambers by the atomization of cold 50° Bé acid by spraying it on the walls of the lead chambers The plant comprises a Glover and Gay Lussac tower, whilst the chambers are replaced by cylindrical towers with lead wall of considerable height (about 18 m) and 6 to 7 m in diam Atomization of the cold acid is effected by a turbo-disperser consisting of a vertical turbine placed below the roof in line with the axis of the tower and controlled by means of a toothed gear, or by direct connection with a vertical electric motor placed on top of the roof and protected from gases and acid sprays The acid is sprayed on to the walls in the form of a dense rain, part of which adheres to the wall and falls in a thin layer which completely covers and cools the lead The other part, dispersed by the impact against the walls, is divided into minute droplets which form a mist of acid, the density of which decreases from the wall to the centre The following conditions are thus realized (1) the lead walls are constantly protected and cooled by a layer of cold acid (2) a dense mist of dilute acid protects the lead wall from the hot nitrous gases of the central portion and provides the water required by the reactions and (3) a hotter central zone These are the optimum conditions for the manufacture of sulphuric acid by this process The transformation of sulphurous acid into sulphuric acid takes place in two successive but independent phases (1) inside the hot zone formation of the nitrous sulphuric acid and (2) towards the wall-hydration of nitrated acid and reduction of nitrous acid and formation of ordinary sulphuric acid

Microscopical Examination of Worn Textile Articles

FOR DESIGNING CLOTH STRUCTURE for specific purposes and for designing machines to evaluate the suitability and serviceability of fabrics for these purposes it is essential to know what happens to the fibres during wear and breakdown of the fabric and whether a similar effect is produced on the fibres by the testing machines. A systematic microscopical examination of fibres from worn textile articles and garments during and at the end of their use together with their comparison with cloths subjected to laboratory tests are detailed in a memoir (No 4, 1949) of the Shirley Institute

The cotton garments and articles examined have comprised shirts, white overalls, khaki overalls pyjamas, handkerchiefs, cushion covers, umbrellas, etc , at various stages of their wear and tear Each garment was thoroughly inspected and a record was made of the structure of the cloth, the position and type of breakdown, and how far and in what manner the warp and weft respectively contributed to this breakdown Microscopical examination was made of the fibres from the worn and torn portions The fluidity of the material was determined from worn parts of the garment and when possible from those parts of the garment which had suffered least wear and tear

The Congo red staining method was used for the microscopical examination of the fibres, the mounts being examined with a 10x eyepiece a ⅙ in objective, and daylight illumination Examination of all the garments has shown certain well-defined factors which contribute to breakdown but which function in varying degrees

A systematic examination has been made of the breakdown of worn linen woollen, silk and rayon fibres The mechanism has been found to be substantially the same in all the fibres All of them break at right angles to the long axis of the fibre as a result of wear, and the cotton and flax show some preliminary cross-markings In none of the fibres does there appear to be any relation between the inclination of the fibrillae and the lines of segmentation

The investigation has shown that although textiles in service undergo a varying amount of chemical deterioration through laundering exposure to light and atmospheric conditions, failure is mainly due to a weakening of the structure caused by mechanical breakdown of the individual fibres and that the mechanism of breakdown is substantially the same for the fibres cotton, wool linen, silk, and rayon Only those fibres held firmly by tension, pressure or filling, suffer intense abrasive action The breakdown of a large proportion of the fibres is caused by transverse cracking which, judging by the location of the position of maximum weakness in the textiles examined, is the direct result of flexing and bending stresses suffered during wear Fibres on the surface which are only lightly held, suffer a gentle abrasive action The general weakening of the fabric structure and the majority of the tears and splits which occur in many worn garments are a direct consequence of this fibre breakdown

Mounting of Coal Specimens for Electron Microscopy

A NEW METHOD OF PREPARING specimens for the electron microscope which reveals more clearly some of the finer details of coal structure not yet fully understood, is reported The technique consists in taking a plastic impression of the surface of a polished cube of coal, and then photographing the impression through an electron microscope The older technique of peeling or slicing thin sections of coal gives specimens which are too thick for study The plastic replicas are about one-tenth of a micron the desirable thickness (*Science Newsletter*, 1949 **56**, 296)

Coal cubes, about the size of large dice, are polished and then placed briefly in an etching bath of chromic acid-sulphuric acid After washing and drying in filtered air, they are dipped in a solution of polyvinyl formal Over this a second layer of film, nitrocellulose, is applied When dry, the double film of polyvinyl formal and nitrocellulose is stripped off This film, bearing an impression of the coal's surface structure, is photographed through the electron microscope

Heavy Forgings Industry in France

THE TECHNICAL CENTRE OF THE heavy forgings industry organized a conference at Paris during 1949 to which representatives of the industry from several foreign countries were invited for exchange of views on the latest developments The papers contributed to the conference are edited and published by the *Documentation Centre for Iron & Steel Industry* (*C D S*) of France, 12 rue de Madrid, Paris 8

The publication contains a report of the speech made by M Mercier, Director of the Technical Centre of the heavy forgings industry, reviewing the origin and activities of the organization which was founded with the object of (1) undertaking a study of problems of interest to the forging industry, (2) serving as an information centre for the various units of the industry and (3) helping the manufacturers by solving specific problems which might arise in the industry

Another interesting article contained in the publication relates to the advances made in the use of forging manipulators which enabled the Americans to produce more forgings at a faster rate with a reduction in man-power per forge unit

Paul Friart, Director-General of Dembiermont Works, in his paper gives a detailed analysis of the costs in heavy forgings taking into account the principal factors, viz metal, heating for forging, the different items which enter into the cost analysis of forging operation, works on cost etc

'The heavy forging press — its application and design ' is an interesting contribution made by J A Sanderson This paper deals with the present position of heavy forges generally in supply, the forgings in demand today in respect of quality dimensions and weight It gives the distribution of the heavy forging presses and makes a critical examination of the position of the heavy forging industry of France

Other interesting contributions deal with thermal treatment of big forge pieces, the manufacture and properties of an alloy steel rotor forging and the refractories employed for lining reheating furnaces The publication is of great value to those interested in the mechanical treatment of metals and the latest researches in that field K VYASULU

Producer-gas for Road Transport

WORK CONDUCTED AT THE *Fuel Research Station*, England, relating to design and development of producer-gas equipment, preparation and examination of suitable fuels, and by controlled tests on the test bench and on the road are described (*Proc Inst mech Engrs*, 1949, **161**, 81)

Supplies of charcoal being inadequate, anthracite and low-temperature coke were examined The performance obtained with anthracite was improved by activating it with sodium carbonate When different coals were carbonized at " low ' temperatures a low-rank, non-coking coal gave a more suitable fuel than a high-ranking coal The effect of variations in the quality of the fuels due to variations in the volatile matter, ash and moisture content and size were studied and a specification for transport producer fuel was prepared

A new dry-blast cross-draught producer, known as Government emergency producer, capable of using either anthracite or low temperature coke was developed The design is simple, and the complete unit is mounted upon a trailer Based upon the performance data available from tests on three producers, a new design was developed incorporating the use of preheated air and steam This new unit is the Government utility producer, and is mounted as a frame unit The above two units were developed for lorries having engines of 2 to 4 litre capacity A number of filtering devices such as fabrics centrifugal granular, fibrous wet washers, etc were examined for the above two types of producers Sisal tow was considered a promising material, and a two-stage filter was developed and used G D JOGLEKAR

Sisal Wax

METHODS RELATING TO THE RECOVERY of wax from sisal leaves are summarized in two patents recently assigned to a British chemical company (*Chem Age* 1949 **61**, 812)

The first of these claims an improved process for the extraction and purification of sisal wax The sisal flesh is extracted with an organic solvent, such as a mixture of benzene and ethyl alcohol, or trichlorethylene, at a temperature approximately the boiling point of the solvent, to extract the wax and other substances The resulting products are treated with an absorbent, comminuted or not to eliminate impurities The solvent is then distilled off After addition of absorbent to the hot wax solution, the whole mixture is subjected to hot filtration and the purified wax filtrate recovered This is then distilled The absorbent may be charcoal, activated carbon alumina, bone meal, etc It may be used in various ways, in one example, the solution is passed through a heated column containing alumina

The second patent is broader in its title and comprises the recovery of wax from plant leaves, especially of sisal, flax, jute and others The proportion of solvent to material treated may in some cases be 5 1 The main steps consist, as before, in extracting the leaves or flesh with an organic solvent at the boiling point, or just below it The solvent is distilled off or the solution cooled to deposit extracts The residue left after distillation or the deposit resulting from cooling is redissolved in the same or similar solvent The solution may be mixed with absorbent before filtering

New Synthetic Rubber

THE DEVELOPMENT OF A NEW TYPE of synthetic rubber-like material is reported at Leverkusen in Germany (*Chem Trade J*, 1949, **125**, 696)

The material is made by the addition reaction between di-isocyanates and the aliphatic linear polyesters which possess hydroxyl or carboxyl groups at the end of their chains Purely aliphatic linear polyesters, such as those made from adipic acid and glycol with molecular weights in the region of 3 000 to 4,000 have so far found no application in the plastics field, since they mostly soften below 100°C By treatment with a di-isocyanates-naphthalene-1-5-di-isocyanate in particular, they give materials possessing properties very similar to those possessed by vulcanized rubber, and these have been given the provisional trade name of " Vulkollan" The di-isocyanate is used in excess and there is evidence that there is some ring formation

Niobium Steel

A NEW NIOBIUM STEEL, G32, mainly for use in the rotor blades in advanced jet engines and turbines, has been developed in the research laboratories and works of *William Jessop & Sons*, Sheffield The steel can operate efficiently under very high stress in the region of 750°C Another steel for duties at temperatures up to 850°C is in the offing (*Chem Trade J*, 1949, **125**, 636).

Niobium steels are also expected to find valuable uses for such purposes as industrial heat-treatment furnaces

Indian Standards

Trichlorethylene—A DRAFT INDIAN standard specification for the 3 grades — chemically pure pharmaceutical and commercial — of trichlorethylene has been developed by the Indian Standards Institution Requirements for the following tests have been prescribed specific gravity residue on evaporation, range of distillation, acidity, free chlorine, chlorides, phosgene, aldehyde and acetylene The stability and the method of storage, marking and delivery are also included

Sodium Thiosulphate Sulphite & Bisulphite — Three draft standards for sodium thiosulphate sodium sulphite and sodium bisulphite have been prepared Commercial, photographic, pharmaceutical and analytical reagent grades are covered for thiosulphate and sulphite while only commercial and photographic grades are specified for bisulphite The requirements relate to purity of materials, *p*H value, and tolerance limits for matter insoluble in water, iron, heavy metals arsenic and other impurities Appendices are included in each draft standard for procedures of sampling and methods of testing the material for conformity to the prescribed requirements

Ethyl, Butyl & Amyl Acetates — The Fine Chemicals Sectional Committee of the Indian Standards Institution has prepared 3 draft Indian standards relating to commercial and pure grades of ethyl acetate, butyl acetate and amyl acetate

Limits have been prescribed for specific gravity, residue on evaporation, acidity, ester content and the quality of liquid distilling between certain specified temperatures at standard atmospheric pressure A test for freedom from water has also been included The draft standards also contain appendices, giving the procedure for sampling and the methods of testing the materials for conformity to requirements

Comments on these draft standards will be received by the Director, Indian Standards Institution, Delhi 2, up to April 1950

Announcements

Indian Science Congress, 1951 — Dr H J Bhaba, F R S, Director of the Tata Institute of Fundamental Research, Bombay, has been elected President of the Indian Science Congress, 1951, to be held in Calcutta The Sectional Presidents are Mathematics Dr C Racine (Madras), Statistics Mr A R Sinha (Calcutta), Physics Dr C S Venkateswaran (Trivandrum), Chemistry Prof R C Shah (Bombay), Geology Dr J B Auden (Calcutta) Botany Dr B B Mundkur (Delhi), Zoology Dr N C Chatterjee (Dehra Dun), Anthropology Mr S S Sircar (Calcutta), Medical and Veterinary Sciences Dr G Sankaran (Calcutta), Agricultural Sciences Dr J K Basu (Calcutta), Engineering Prof M S Thacker (Bangalore)

The Pan-Indian Ocean Science Congress (*PIOC*), sponsored on the lines of the Pan-Pacific Science Congress, will hold its first session in India immediately after the 1951 session of the Indian Science Congress

The Council of the National Institute of Sciences has elected the following foreign scientists as honorary fellows Prof P Debye (Cornell University, U S A), Prof M Von Laue (Berlin University), Prof Ervin Schordingar (Institute for Advanced Studies, Dublin) and Prof M Seigbann (University of Uppsala Sweden)

The following office bearers were elected for the year 1950 President, Prof S N Bose, Vice-Presidents, Prof A C Banerji and Dr K S Krishnan, Foreign Secretary Dr J N Mukherjee, Secretaries Prof D S Kothari and Dr H S Pruthi

The Indian Academy of Sciences — Dr C V Raman has been elected President of the Indian Academy of Sciences for the term 1949-52 at the 15th Annual Meeting of the Academy held at Bombay Prof S Bhagwantam of Osmania University Dr V R Khanolkar of the Tata Memorial Hospital, Bombay, Dr Mata Prasad Principal of the Royal Institute of Science Bombay, and Prof T R Seshadri of Delhi University, have been elected Vice-Presidents

The Nobel Prize in Chemistry for 1949 has been awarded to Prof G F Giauque of the University of California

Prof M S Thacker, head of the Power Engineering Department of the Indian Institute of Science, Bangalore, has been elected a Fellow of the American Institute of Electrical Engineers

The Lady Tata Memorial Trust are offering six scholarships of Rs. 250 each per month for the year 1950-51, commencing 1st July 1950 Applicants must be of Indian nationality and graduates in Medicine or Science of a recognized university The scholarships are tenable in India only and the holders must undertake to work wholetime under the direction of a recognized research institute or laboratory For details write to the Secretary, the Lady Tata Memorial Trust, Bombay House, Bruce Street, Fort, Bombay 1

Publications Received

High Polymeric Chemistry, by W S PENN, Chapman & Hall Ltd, 1949, xvi + 487, price 36*s*

Modern Plastics (2nd edition), by HARRY BARRON, Chapman & Hall Ltd, 1949, xx + 779, price 50*s* net

Photoelasticity — Principles & Methods by H T JESSOP & F C HARRIS Cleaver-Hume Press Ltd, 1949, pp viii + 184, price 28*s* net

The Indian Cotton Textile Industry — 1949 Annual (Vol XII), by M P GANDHI, Gandhi & Co, 1949, pp liv + 174 + xxxi, price Rs 6

Manufacturing Analysis, by RICHARD F KIPERS, McGraw-Hill Book Co Inc, 1949, pp xi + 452, price $5 00

Glass-to-Metal Seals, by J H PARTRIDGE, The Society of Glass Technology, Sheffield 10, 1949, pp xii + 238, price £1/15/-

American Chemical Industry (Vol VI), by WILLIAMS HAYNES, Macmillan & Co Ltd 1949, pp viii + 559, price $10 00

Elements of Internal Combustion Turbine Theory, by H T ADAMS, Macmillan & Co Ltd, 1949, pp xii + 176, price 16*s* net

Recent Advances in Radio Receivers by L A MOXON, Macmillan & Co Ltd, 1949, pp ix + 183, price 18*s* net

Introduction to Chemical Engineering Thermodynamics (1st ed), by J M SMITH, McGraw Hill-Book Co Inc, 1949 pp x + 386, price not indicated

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for January 1950

Plastics & Plasticizers

41762 Thermosetting resinous compositions *Urea-formaldehyde or melamine formaldehyde resin together with* 0·05 *per cent tetrachlorophthalic acid or anhydride based on weight of resin* — British Industrial Plastics Ltd

Inorganic Chemicals

41510 Manufacture of ammonium nitrate *Introducing ammonia and nitric acid into lower part of a saturator and subjecting the solution in the saturator to an intensive circulation so that the solution in the upper part is sent back to the lower part* — Montecatini, Societa Generale per L'Industria Mineraria e Chimica

41799 Ammonium nitrate (Addition to No 39992) *Comprises ammonium nitrate and a soluble salt of a poly-sulphonated derivative of a diamino or triamino-substituted triaryl methane dyestuff* — I C I Ltd

Organic Chemicals

41547 Production of acetylene other gases and carbon black from liquid hydrocarbons *Intermittent electric arc discharges between a multiplicity of conducting particles loosely disposed in a shallow layer immersed in the hydrocarbon generating acetylene and gas carbon black, a by-product* — Ediger

41585 New sulphonamide derivatives *By condensation of a sulphonyl halide,* $R\text{-}SO_2X$ with $A_1\text{-}(R_2)_2$, *a secondary amine* $(R^1)_2N\text{-}A\ NH$ — Societe des Usines Chimiques Rhone-Poulenc

40186 Biguanide derivatives *Condensing p-chlorophenylthiourea with isopropylguanidine in presence of desulphurizing agent in non-polar solvent* — Societe des Usines Chimiques Rhone-Poulenc

Miscellaneous Chemicals

39858 Metallic compounds of amino acids *Digesting proteinous material to free amino acids and reacting the amino acids with a metal compound* — Medical Research Proprietary Ltd

41657 Insecticidal and weed-killing compositions *Dissolving amine salts of dinitro-orthocresol in water, oil or alcohol to get desired concentrations* — Marks & Co Ltd

41883 New antioxidants *Condensing mixtures of 2 4-dimethylphenol and 2 5-dimethylphenol with aliphatic aldehydes* — I C I Ltd

41884 Antioxidants from non-aldehydes and 2 4-dialkylphenols *Condensing a non-aldehyde with a 2 4-dialkylphenol* — I C I Ltd

Lumber & Wood Products

39878 Process of treating wood *Applying to end of freshly cut green log a sugar solution having osmotic action on wood and causing it travel through the log* — Tenger

Drugs & Pharmaceuticals

41859 Manufacture of organic amine salts of penicillin *By reacting a water-soluble salt of β-diethylamino ethyl p-aminobenzoate with a tertiary amine salt of penicillin* — I C I Ltd

Metals & Metal Products

42235 Surface treatment of metals *Chromising metal, applying thereafter superficial layer of aluminium and oxidizing the latter* — Metal Gas Company Ltd

41820 Phosphors and method of making them *Incorporating usual ingredients magnesium oxide and 1 per cent of lead compound unharmful to the calcium tungstate phosphor* — Westinghouse Electric Corpn

41221 Process for the simultaneous recovery of base metals in powder form and of metallic salts *Solid compounds of base metals containing minimum quantity of water necessary for reaction are placed in intimate contact with alkali amalgams whereby metals are precipitated* — Erzhutte Aktiengesellschaft

41601 Aluminium and its alloys *The primary alloy got by reducing is treated with metallic extracting agent which gives a liquid intermediary alloy and a solid residue, which are separated on a perforated plate The residue is washed on the plate by pure extracting metal got from distillation of intermediary alloy and the washing liquid used for further extraction* — Loevenstein & Fondal

Textile & Textile Products

39983 Mechanical doffing of spinning and like frames *Comprising driving, starting and stopping means for the carriage, and means for unlatching the carriage* — The British Cotton Industry Res Assoc

Miscellaneous

40405 Machine for the preparation of beaten rice *Comprising a circular hoop with a perforated bottom and a flat roller mounted inside the hoop* — Chowdhary

41677 Improved machine for cutting and stacking plant leaves and the like, such as the leaves of *tendu* or tobacco for use in the manufacture of bidi cigarettes *Comprises a die plate with an aperture and reciprocating cutting punch mounted for a cutting operation in relation to the die plate* — Gupta

40312 Water lift *Two trapezoidal buckets provided with spouts and with curved ends of bars fitted to the rims, a catch basin with roller sleeved elbow rods and spouts a funnel below the catch basin* — Mudaliyar

Patented Inventions of the Council of Scientific & Industrial Research

AN ENZYMIC METHOD FOR THE PRODUCTION OF CALCIUM GLUCONATE

Indian Patent No 39441 U S A & U K Patents Pending

M Damodaran P S Rangachari & K V Ramkrishnan

The process is based upon the original observation that while the production of citric acid by fungi requires the integrated activity of the intact living cell gluconic acid production by the same organism takes place as a result of the action of a single enzyme which can function independently of the living cell It marks a departure from existing processes for the production of calcium gluconate by biological means which depend upon the use of living cultures of fungi such as *Aspergilli* and *Penicillia* The production of calcium gluconate according to the present invention consists in the oxidation of solutions containing glucose to gluconic acid by means of non viable preparations containing glucose oxidase obtained from *Aspergillus niger* or the like micro organisms containing glucose oxidase The non viable preparations consist of macerates dehydrated powders or extracts prepared from the micro organisms The mycelial mat from citric acid fermentation by *Aspergillus niger* may be employed

MANUFACTURE OF SORBOSE FROM SORBITOL

Patent No 39442

M Damodaran & S S Subramanian

The invention relates to the manufacture of the sugar sorbose which is the starting material for the technical synthesis of vitamin C

An extract of brans or of germinated seeds is used as the medium of fermentation in the manufacture of sorbose by the bacterial oxidation of sorbitol Extracts prepared from rice bran or wheat bran or from germinated *cholam* have yielded the best results The bran extract is prepared by the extraction of bran with acidulated water Hydrochloric or sulphuric acid may be used for acidulating the water which may contain 25 to 75 per cent by volume of concentrated hydrochloric acid (33 per cent) Germinated seed (*cholam*) extract is prepared by grinding germinating seeds and extracting with boiling water Oxygen or air under pressure is employed for accelerating the process

The invention is the outcome of efforts to find cheaper or better substitutes for yeast extract which has hitherto been used as nutrient in the bacterial oxidation of sorbitol

PROCESS FOR THE MANUFACTURE OF A DIASTATICALLY ACTIVE MOLDY COMPOSITION

Indian Patent No 39991

M R R Rao & M Sreenivasaya

While it is known that fungi usually grow on husks brans or the like the usual practice hitherto has been to grow it on bran which alone has been known to provide the essential requirements of fungus growth whereas husks straws or the like by themselves cannot provide the nutrients adequately and result in poor yields

This invention aims at producing a comparable growth of fungus on fibrous materials other than bran It consists in providing the fungus with a bed (or soil) with a tilth (or texture) for the growth of the fungus the bed consisting of indigenous fibrous materials other than bran such as husks straws disintegrated bagasse or asbestos fibres or the like and is characterized in that the beds are supplemented with nutrients providing carbon nitrogen and minerals By supplementing the beds with nutrients more luxurious growth of the fungus with higher concentrations of diastase is secured The fungus employed is a variety of the strains of fungi belonging to the *Aspergilli* and *Penicillia*

The fungus is provided with a balanced composition of nutrients and is furnished with conditions of aeration tilth of substrate etc which secure for it optimum conditions of vigorous growth and formation of enzymes The essential requirements of the fungus have been found to be (i) loose and porous tilth or texture for facilitating retention of moisture and securing continuous and efficient aeration (ii) an appropriate source of carbohydrate (iii) an assimilable source of nitrogen (iv) a supply of minerals particularly calcium potassium and phosphates (v) optimum moisture content (vi) optimum *p*H (vii) optimum temperature and (viii) freedom from extraneous infection

Science & State Aid

"MONEY spent on fundamental research is not money wasted on empty prestige but is a good and necessary investment which progressive nations will do well not to grudge When we reach a critical point in anything it is only science that can help

It would be unwisdom to limit scientific research It is a good investment to give as much as we can to eminent men devoted to the cause of searching truth Research is most often a game of finding the needle in the haystack Scientists may seem to be idling their time and wasting plenty of money But the needle can be found by some one if many are engaged in seemingly profitless work

These observations on science and research made by H E Sri C Rajagopalachari at the opening ceremony of the National Physical Laboratory are of more than ordinary interest in the context of the much discussed questions of State aid planning and direction of research They emphasize the pre-eminent position of fundamental research in any programme of scientific development and the need for aid to such research without restrictive conditions This robust faith shows an enlightened recognition of the enduring values of science in relation to human progress which all those entrusted with the responsibility of planning financing and administering of research projects would do well to ponder over

There has been an almost universal recognition of the urgency for raising the tempo of scientific research in every country This has been a noteworthy feature of the post war period and is perhaps traceable to the demonstrable contributions which science made to the war effort The ordinary citizen was thus awakened to the practical possibilities and social consequences of science This public recognition which is a positive gain to science is the direct outcome of the close partnership between government science and industry brought about under the stress of an emergency when the gap between research and utilization was bridged and all scientific effort was directed unerringly to a well defined end Well may it be asked why science which produced such remarkable results during the war should not be equally effective in solving the many problems in peace time ?

The first link in the chain of events — research development production and use — is research whose value was first established in the 17th century The scientific method of observation theory and experiment replaced the scholastic method of argument in man s endeavour to understand natural phenomena Since then the march of science has been triumphant and it has served to extend the empire of man and to ameliorate the condition of man Science has become the source of knowledge indispensable to the progress of civilization without which the thoughts of man run in circles and all progress ceases To provide the requirements of a growing population there is undoubted need for rendering the techniques of developing natural resources continuously more effective through investigation and research It is this realization that has led governments in various countries to extend aid to research on a scale that would not have been deemed possible a few years ago Thus in the United Kingdom the annual research expenditure (about 100 million pounds) is a little over one per cent of the national income in the United States of America it is a little less than one per cent and amounts to about 2 000 million dollars Compared to these appropriations research expenditure in India is small and is estimated to be one fiftieth of one per cent of the national income It is encouraging however that there is a growing appreciation of the importance of research in India and recent developments have shown that Government aid is becoming generous and substantial

The increasing support which governments have begun to extend to scientific research raises a few questions Does State aid necessarily mean emphasis on utilitarian research? If so what are its repercussions on the progress of fundamental research? State patronage is welcome — nay necessary — if research is to expand in volume and intensity Science like the fine arts has sought and flourished under patronage Government however cannot remain unconcerned to the practical outcome of such aided research Government quite properly invests its money in areas which bring a return to the tax payer Writes Dr Alan T Waterman of the Office of Naval Research Washington D C in this connection

Uncle Sam is properly a realist He may believe in charitable donation for some of the people all the time for all the people some of the time but not for all the people all the time In general he expects to pay only for services rendered Thus the federal government does not provide financial support unless a need can be established and when such support is provided it must be expected to show some return to the taxpayer * The utilitarian aspect thus receives emphasis under any scheme of Government sponsored research and such research is concerned with development based on existing knowledge rather than with the creation of new knowledge and is likely to prove attractive to most men The emphasis on application is attended by the danger to which Dr Vannevar Bush draws attention in his *Science — the Endless Frontier* viz that applied research tends to drive out fundamental research This danger must be guarded against the State support should be so directed that the sources of knowledge are maintained at the highest level of functional efficiency

H E Sri C Rajagopalachari says in this connection If we limit the efforts and the operations of scientific men within utilitarian plans and schemes we may make small and useful routine achievements but the biggest discoveries never come that way They come so to say by accident and indirectly and then the discovery produces an enormous gift for human progress and happiness This enlightened assessment of the relative values of development research and fundamental research affords a weighty support to the view that fundamental research is entitled to State aid in its own right regardless of the practical outcome

Recent surveys of government allocations in the U K and U S A have brought home the fact that grants to fundamental research represent but a small proportion of the total and fall far short of the requirements The problem of restoring the balance between research and development programmes has received careful scrutiny and there is emphatic support to the view that fundamental research should be encouraged and fostered on a generous scale For instance in the U S A the expenditure on fundamental research is to be quadrupled and federal support to universities and non profit research institutions is to be progressively increased to at least 250 million dollars by 1957 The view that support on a liberal scale to the traditional centres of research viz the universities would bring handsome returns is now fully accepted and such support should form a part of an overall plan for raising the standard of higher education This would alleviate the shortage of trained manpower — a shortage which prevails in most countries and has restricted many a programme of development Scientific development in the ultimate analysis depends on the quality and calibre of research workers and the strengthening of universities with the view of not only augmenting facilities for free and unrestricted inquiry but also of ensuring the training of youth for a research career is an urgent necessity

Progress of science does not depend merely on the accumulation of new facts it depends on the continuous development of new and fruitful concepts and it is through proper education and training that creative talents can be encouraged and qualities essential for exploration and discovery developed Under the care of an enlightened National Government science in India is beginning to receive the recognition and encouragement which had been denied to it so far. The observations of India's leaders provide an assurance that State aid to science would be liberal and that the needs of scientific inquiry would be met What is needed is leadership for the development of universities which would be as effective as that we have for scientific research and which has secured improved facilities and a network of eleven National Laboratories We hope that the attention given to scientific development would be supplemented by an equally energetic attention to universities, which set the standard for the quality and tempo of research, and serve not only as centres of fundamental research but also as institutions for research scholars

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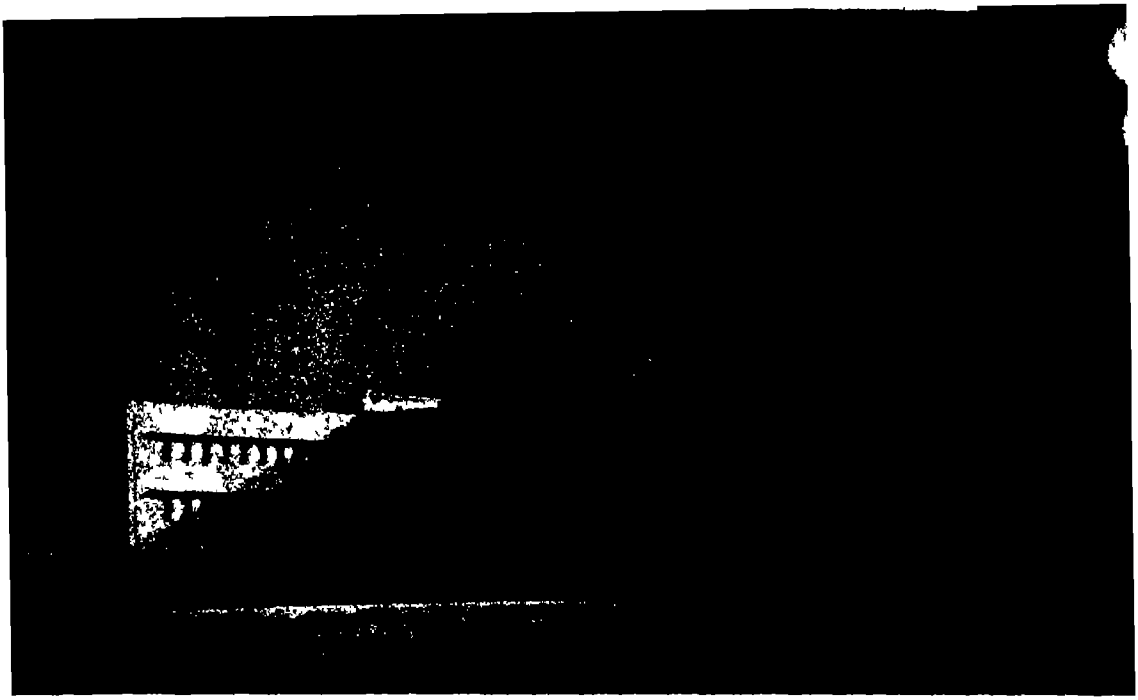
* *Science* 1949 110 703

National Planning Commission

THE TERMS OF REFERENCE TO THE NATIONAL Planning Commission appointed by the Government of India include (1) the assessment of the material, capital and human resources of the country, including technical personnel, and the investigation of possibilities of augmenting such of these resources as are found to be deficient in relation to the nation's requirements, (2) the formulation of a plan for the most effective and balanced utilization of the country's resources, (3) the determination of priorities, defining the stages in which the plan should be carried out, and proposing the allocation of resources for the due completion of each stage, (4) the indication of factors which are tending to retard economic development, and determining the conditions which, in view of the current social and political situation, should be established for the successful execution of the plan, (5) the determination of the nature of the machinery which will be necessary for securing the successful implementation of each stage of the plan in all its aspects, (6) the appraisal from time to time of the progress achieved in the execution of each stage of the plan and recommending the adjustments of policy and measures that such appraisal may show to be necessary, and (7) the recommendation of such interim or ancillary measures as appear to it to be appropriate either for facilitating the discharge of the duties assigned to it, or on a consideration of the prevailing economic conditions, current politics, measures and development programmes, or on an examination of such specific problems as may be referred to it for advice by Central or State Governments

The Commission, which will make recommendations to the Cabinet, will act in close understanding and consultation with the Ministries of the Central Government and the Governments of the States Responsibility for taking and implementing decisions will rest with the Central and the State Governments

The work of the Planning Commission will affect decisively the future welfare of the people in every sphere of national life Its success will depend on the extent to which it enlists the association and co-operation of the people at all levels The Government of India, therefore, earnestly hope that in carrying out its work, the Commission will receive the maximum support and goodwill from all interests and, in particular, from industry and labour



THE NATIONAL PHYSICAL

OPENING CEREMONY,

THE National Physical Laboratory is the second in the chain of eleven National Laboratories to be declared open At an impressive ceremony which took place in Delhi on January 21, 1950, Sardar Vallabhbhai Patel, Deputy Prime Minister of India, declared the Laboratory open before a distinguished gathering of scientists, industrialists and public men His Excellency Sri Chakravarti Rajagopalachari, Governor General of India, presided over the function

Three years ago Delhi witnessed a similar gathering of the scientific fraternity and the public when Pandit Jawahar Lal Nehru laid the foundation stone of the magnificent structure that is now the National Physical Laboratory The construction work was taken up a year later and progressed rapidly The front block of the building, with its imposing tower, was ready for occupation in the latter part of 1949

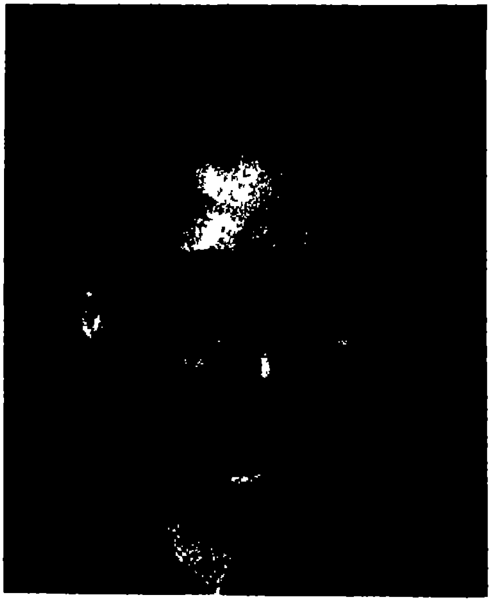
The National Physical Laboratory owes its inception to the vision, energy and resourcefulness of Dr Shanti Swarup Bhatnagar It was in 1941 that Dr Bhatnagar put forward specific recommendations for the establishment of the Laboratory These recommendations were accepted by the Government, and in 1945 funds were made available for the work A Planning Committee was appointed, and after a searching inquiry into the needs of physical research in the country, and a study of the designs and equipment of physical laboratories in the United Kingdom and the United States of America, the committee formulated plans In finalizing the plans, in speeding up the building work and in equipping the laboratory, the Council — nay, the country — was fortunate in having the guidance and direction of Dr Shanti Swarup Bhatnagar In the words of the Governor General of India " the cause of advancement of science in India has found in Dr Bhatnagar a great organizer "

The growth of the science of physics in India during the present century has been rapid and impressive The first noteworthy contribution to modern physics by an Indian scientist which received world attention was

LABORATORY, INDIA

JANUARY 21, 1950

on the generation of ultra-short electric waves, and this was by Sir J C Bose in 1895 Since then, Indian physicists have made many significant contributions to the advancement of physics, notably in optics, acoustics, magnetism, cosmic rays and astrophysics The establishment of the University College of Science at Calcutta in 1915 gave an impetus to organized research, and many important discoveries emanated from the Calcutta University and from the Indian Association for the Cultivation of Science The development of research facilities in universities, Government scientific departments and research institutions accelerated the growth of research The last decade witnessed the establishment of the Raman Research Institute at Bangalore, and the Tata Institute of Fundamental Research at Bombay The names of Prof C V Raman, F R S, Prof M N Saha, F R S, Prof K S Krishnan, F R S, and Prof H J Bhaba, F R S, are known wherever the science of physics is taught and studied These scientists have inspired many young men and women and



Dr K S Krishnan, Director, National Physical Laboratory have established important schools of research all over the country

These developments, impressive and important as they undoubtedly are, have emphasized the need for even greater facilities and specialized large-scale laboratories To quote the words of Dr S S Bhatnagar "One aspect of fundamental research work which can hardly be neglected in India is that which requires specialized, large-scale laboratories During recent years, and particularly during the last World War, organization of scientific work has undergone vast changes Not only does some of the present type of work require large-scale specialized organizations well outside the scope of university work, but also expenditure of large sums of money which could only be justified if diversified, co-ordinated and regulated application and professional continuity of work are guaranteed This is not usually possible in the universities where teaching and research necessarily go hand in hand, and are essentially preparatory Research work there is bound to be scrappy, discontinuous and unco-ordinated Those who long for the old days with lone worker in a damp basement room with his wax and string and glass-blowing torch, can have them I believe that the essential spirit of the old days — freedom of enquiry and time for thought — can be obtained even in the pressure of great new physical and organizational techniques It is a fact that fundamental research has now become a huge organized industry in itself"

The National Physical Laboratory has been carefully designed and expertly planned to meet the exacting needs of research. The main features of the building are the provision of air-conditioning, flexibility, which allows a change in the sizes of rooms in steps of six feet units, and a long basement which serves as a store as well as a tunnel for services such as gas, steam, water, electricity and compressed air These services lie vertically in every room in the Laboratory without winding themselves round the walls and corridors, thus saving lakhs of rupees and providing means of introducing any new service lines, which may be necessary, without having to dig into the walls and floors of the rooms

Sardar Vallabhbhai Patel opening the Laboratory

HIS EXCELLENCY SRI C RAJAGOPALACHARI DELIVERING HIS SPEECH

The main functions of the Laboratory relate to the maintenance of standards in all branches of physical science where precision of measurement is required This refers not only to the fundamental standards of mass, length and time, but also to derived standards like those required for electrical and elctronic instruments, temperature, luminosity, properties of metals and their behaviour, purity of chemicals for spectroscopic and other specialized applications In fact, the whole range of scientific work which calls for instrumentation falls within the scope of the Laboratory It will also be concerned with problems of physical research, which relate fundamentally to the utilization and processing of raw materials for industry, standardization of processes, and scientific controls for improvement in the quality of industrial products Another important function of the Laboratory will be to give advice on the framing of specifications and of devising suitable tests, whereby the quality of manufactured products could be easily tested in the Laboratory This work of the Laboratory will eventually raise the standard of industrial efficiency by helping in systematizing industry to a common measure of fundamental standards, specifications, control of quality, performance and practice

The work of the Laboratory will be carried out through the following nine divisions Weights and Measures, Applied Mechanics and Materials, Heat and Power Optics, Electricity, Electronics and Sound, Industrial Physics, Hydraulic Research and Analytical Chemistry Its work is directed by the distinguished Indian physicist Dr. K S Krishnan whose " fame as a physicist transcends the limits of this country " He is one of the big men of science who are India's pride He is a scholar of eminence, and his genius " rests on the solid foundation of innate culture and a balance without which co-operative effort in research is an impossibility " Dr K S Krishnan is assisted by a team of eminent scientists, each distinguished in a special branch of physics

Declaring the Laboratory open, Sardar Vallabhbhai Patel said " The magnificent building set in such picturesque surroundings indicates that while it is no answer to the spiritualist's doubts or the humanist's despair, it is essentially a response to the man's call for precision and perfection It will combine the emotional zeal of the fundamentalist with the practical approach of the utilitarian It will furnish that scientific aid to industry without which the present-day industrial efficiency would soon find itself lost in the desert sands of dead habit " He asked the distinguished scientists present " whether science in its quest for Nature's secrets " is going to advance human race towards its goal of eternal happiness or whether it will open a veritable Pandora's box of evil forces for the destruction of mankind " It is my earnest and sincere prayer that this Laboratory and the distinguished band of research workers who will operate in it will provide a positive answer to this problem as an inspiration to their fellow-scientists in other parts of the world "

His Excellency Sri Chakravarti Rajagopalachari referred in his address to research expenditure and pointed out that " money spent on fundamental research is not money wasted on empty prestige, but is a good and necessary investment which progressive nations will do well not to grudge " He continued " It would be unwisdom to limit scientific research If we limit the efforts and operations of scientific men strictly within utilitarian plans and schemes, we may make small and useful routine achievements, but the biggest discoveries never come that way " He hoped that search for truth, which is the ultimate goal of all scientific research, should go on, and India should contribute her share of work in science and take her share of fame in return " There is no medium for international prestige as effective as scientific research Our laboratories are our best embassies "

The foreign scientists who were present at the opening ceremony offered their best wishes for the success of the Laboratory. Founded under such good auspices and with abundant goodwill to back it, the National Physical Laboratory starts on its career of exploration of science with its endless frontiers Men of goodwill all over the world will join His Excellency Sri C Rajagopalachari in the wish that love of truth for its own sake, and the spirit of investigation with all its vigour would inspire those who will work in this Laboratory

Characteristics of the Ionosphere over Calcutta (January 1950)

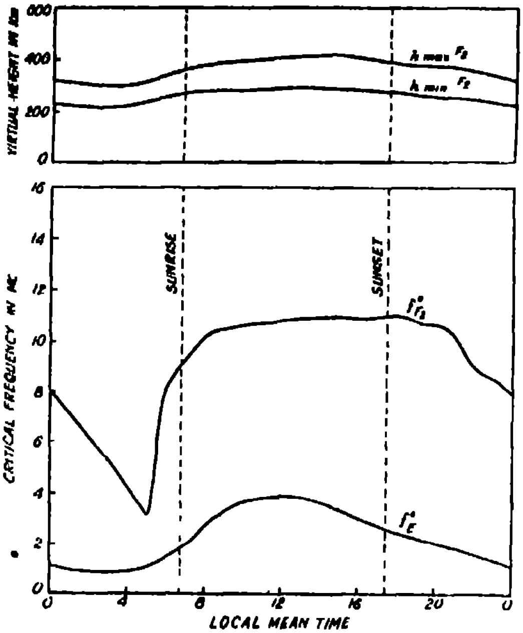
S S BARAL, R K MITRA, D C CHOUDHURY, (MRS) T K BHAR & A P MITRA

Wireless Laboratory, University College of Science, Calcutta

THE following are the ionospheric data observed at Calcutta for the month of January 1950

Fig 1 represents the mean hourly values of the penetration frequency of the F region and the penetration frequencies and virtual heights of region F_2 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of April 1950 Table I gives the different occasions during routine observation when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights

Sporadic E ionization was found to occur less frequently in this month Absorption of normal E echoes at mid-day was also less The behaviour of region F_2 was found to be normal in this month



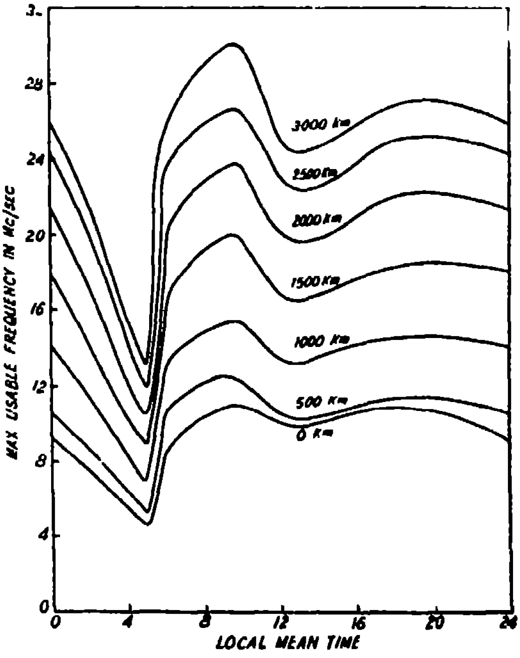
(5 HR 54 MIN AHEAD OF G M T)
FIG. 1 — JANUARY 1950

TABLE I

MONTH & YEAR	DATE	HOUR	$f^{\circ}E_s$ Mc	h_{E_s} km
January 1950	2	22 00	7 55	105
		23 00	7 00	105
	4	08 00	4 15	105
		09 00	4 30	105
	6	18 00	2 85	90
		21 00	3 00	90
	7	08 00	3 10	90
	9	17 00	3 00	105
		21 00	2 75	90
	10	03 00	2 90	90
		04 00	3 15	105
		1[illegible] 00	4 75	120
		16 00	6 50	120
		17 00	4 00	105
		18 00	4 20	105
		22 00	3 00	90

TABLE I — *contd*

MONTH & YEAR	DATE	HOUR	$f^{\circ}E_s$ Mc	h_{E_s} km.
January 1950	16	17 00	3 30	105
		18.00	3 35	105
	17	18 00	3 20	90
	19	16 00	3 20	105
		17 00	3 20	90
		20 00	3 00	90
	20	19 00	3 00	90
		20 00	2 50	90
		21 00	2 55	90
	26	16 00	4 25	105
	27	19 00	3 00	90
		22 00	4 00	90
	30	17 00	3 35	105



AT POINT OF REFLECTION
FIG. 2 — PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF APRIL 1950

Studies in Seismology in the India Meteorological Department

K S AGARWALA
India Meteorological Department, New Delhi

THE study of seismology in India has been receiving attention mainly from three Government departments, viz the Geological Survey of India, the Survey of India Department and the India Meteorological Department The Geological Survey has published a large number of monographs giving detailed study and survey of earthquakes in India and neighbouring areas On the other hand, the cognate studies of the Survey of India on gravity anomalies have suggested some useful ideas on earthquake problems Seismology is also included among the scientific functions of the India Meteorological Department which has carried out a good deal of work in this direction during the past forty years An endeavour is made here to give a brief review of the work so far done in the India Meteorological Department

The first seismograph in India was installed by Dr Moos at Bombay in 1898 Later, more instruments of the eye-reading type were installed by the India Meteorological Department at Simla Calcutta, Kodaikanal and Agra and by the Survey of India at Dehra Dun In 1905 Omori-Ewing instruments were also set up at Simla, Colaba (Bombay) and Calcutta Sensitive photographic recording Instruments of the Milne-Shaw type were installed in India during 1922-25 The department at present maintains four seismological observatories at Colaba (Bombay), Calcutta, Delhi and Kodaikanal, besides an experimental station at Poona These observatories are equipped with Milne-Shaw seismographs supplemented by Omori-Ewing instruments Since 1948 sensitive high-magnification Wood-Anderson seismographs have also been set up at Bombay and Delhi and a few more instruments of this type are expected to be installed soon There are seismological observatories at Dehra Dun and Hyderabad also, which are maintained by the Survey of India and the Nizamiah Observatory respectively It may be pointed out that India lags much behind some advanced countries in the establishment of a network of seismological observatories and that the installations in use at its existing observatories are also inadequate In the U S A there are many whole-time seismologists and over 40 seismological observatories which are generally equipped with the following four types of instruments (i) accelerographs or strong-motion seismographs for recording ground movements of destructive magnitude, (ii) high-sensitivity seismographs for recording weak local shocks, (iii) "intermediate type" instruments for location of earthquakes up to 1,000 miles distant and (iv) "long range" seismographs for registering distant earthquakes In Japan (which lies in the seismic zone) over a hundred seismological stations are maintained with a large number of whole-time seismologists working in them In India, however, not even a dozen seismological observatories are functioning yet and there are only two whole-time seismological officers

The seismological data collected at the Colaba observatory were being published in the annual Bombay Observatory volumes along with magnetic and meteorological data All seismological data, however, began to be published in the department's annual publication *India Weather Review* from 1908 In 1938 the department started a *Quarterly Seismological Bulletin* for the publication, in a convenient form of all the available seismic data obtained from departmental observatories as well as from Hyderabad, Dehra Dun and Colombo Information regarding shocks felt and reported by voluntary observers in India is also included in these quarterly bulletins

The first departmental paper[1] on the "Simla Seismograms obtained between June 1905 and November 1908" was published in 1909 The chief centre of seismological studies in the India Meteorological Department has been the Colaba Observatory Bombay At this Observatory comprehensive studies[2,3] of microseisms associated with disturbed weather in the Indian seas have been made with the help of Milne Shaw instruments These studies have led the way in recent years to the development of a method of locating the position of storms at sea Investigations have also been carried out on artificial vibrations of ground[4] Microseisms and their application to the forecasting of certain weather situations in India have also been studied[5,6] in more recent years A few sets of Strengnether microseismic equipment have very recently been obtained from America to get bearings of storms and cyclones in the Indian seas from an analysis of the microseisms and are being set up for use The theory[7] of seismometers has been discussed in two recent papers The distribution of earthquakes in India and neighbourhood has also been studied[8]

Important earthquakes which have occurred in India and her neighbourhood have formed the subject of detailed study in the India Meteorological Department The seismograms of the great Bihar earthquake of 15th January 1934 have been studied and the detailed results published[9] in a memoir of the Geological Survey Another severe earthquake occurring in India in recent years was the Baluchistan (Quetta) earthquake of 31st May 1935 Seismological studies of this earthquake have also been made[10,11] The seismological features of the Satpura Range earthquake[12] of 14th March 1948 and of the Hindukush earthquake[13] of 21st November 1939 have also been studied The special features of the Mekran earthquake of the 28th November 1945 which occurred in the neighbourhood of India have also been examined and discussed[14] Attention has also been paid to the study of some noteworthy earthquakes which occurred outside India e g the very large Pacific earthquake of 10th November 1938 the catastrophic Chilean earthquake of 25th January 1939 the Anatolian earthquake of 27th December 1939 the Rumanian earthquake of 10th November 1940 and the Mexican earthquake of 15th April 1941

During the past few years the department has given considerable attention to the improvement of existing seismological instruments as well as to the design and construction of new seismic instruments suitable for use at Indian observatories During the great Bihar earthquake of the 15th January 1934 the couplings between the mirror and the boom in the Milne Shaw instrument were dislodged to prevent such a happening in future a suitable mechanical device was developed at Agra At Poona the electric motor for the recording unit of the Milne Shaw seismograph was remodelled into a quick run drive in order to obtain a more open time scale At Colaba valuable experimental work has been done on the design of hydraulic seismographs[15] An experimental seismological station has been set up at Poona recently for the purpose of developing new instrumental methods and techniques A horizontal strong motion seismograph of the Jaggar pattern embodying some improvements was constructed and tried Very recently a satisfactory apparatus of the Wood Anderson type has been evolved and several instruments on this model have been constructed at the departmental workshop at Poona[16] The Poona workshop has also recently made eclipse clocks for use at different seismograph stations to give contacts of definite duration every minute and hour In order to study short period vibrations in earthquake zones in India a quick run recorder has been designed and constructed recently For driving these recorders in places where electricity may not be available a weight driven governor controlled clock has also been constructed[17] The ultimate aim is to obviate the necessity of importing costly seismic instruments as far as possible

The expansion of the seismological organization in India was held up during the recent war but since the termination of the war the matter has again been engaging the attention of the department The Special Seismological Branch which was formed in 1939 with the appointment of a Special Officer for Seismological Research was strengthened by the posting of an Assistant Seismologist from 1st March 1947 During the last 3 years a considerable amount of planning work for the expansion of the seismological organization in India has been done Plans are in hand for setting up a first class seismological observatory at Shillong (which falls in the region of intense seismic activity and where the headquarters of the Seismological Organization is to be set up) and also for the installation of seismographs at a few other new stations in the country In connection with the multi purpose and water power projects of the Central Water power Irrigation and Navigation Commission plans have been prepared for setting up a high class seismological station with a number of accelerograph stations around the proposed site of the Kosi river dam The object is to investigate the movements to which the foundations will be subjected in the event of earthquakes of given intensity in that area It is also planned to establish a seismological observatory in the Damodar catchment in view of the importance of the study of seismicity of that catchment in connection with the Damodar Valley Project

In view of the many large multi purpose schemes of construction which have been undertaken in the earthquake zone of India and risk of damage to them by earthquakes the need for the early implementation of the plans referred to above as well as of those recommended[18] in 1948 by the Planning Committee for Geophysics appointed by the Government of India is manifest It may however be emphasized that not only the *scientific* but also the *economic* aspects have to be kept in the forefront in the future programme of development of the seismological organization in India

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Abbreviations for Titles of Periodicals

The draft standard which has been prepared to assist scientific workers to conform to rational conventions in the method of reference to scientific literature covers the abbreviations for titles of the principal periodicals published in European languages and is based on the Draft Recommendations of the International Standards Organization on the subject In order to meet Indian requirements the rules have been modified and the list of abbreviations including common generic and geographical terms has been extended Comments on the draft are invited by the Director Indian Standards Institution 19 University Road Delhi 2

Rock Salt Deposits of Mandi*

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WITH the partition of the country, Mandi salt deposits constitute the only source of rock salt in India This factor combined with the fact that there is a deficit of about half a million tons of salt in the country makes a strong case for the immediate development of the salt industry in Mandi

Mandi is one of the important Punjab Hill States comprising an area of about 1,200 sq miles The nearest railway station is Nagrota which is connected to Mandi by a 75-mile road Mandi town (elevation 2,200') is situated on the left bank of Beas river which runs northwards for a couple of miles along the zone of the main boundary fault No outcrops of salt are visible, but the salt-bearing formation outcrops extensively along the western flank of the mountain Gokhar-ki-Dhar along the main boundary fault from Joginder Nagar to Mandi Detailed exploratory work of this area has not been undertaken

Geology — The great Himalayan boundary fault runs north-west to south-east along the foot of the mountain Gokhar-ki-Dhar The rocks comprise the Autochthonous Fold Belt — "tightly compressed, vertically disposed strata or of recumbent folds intervening between the crystalline schists of the nappe zone and the foreland of Murrees" The contact between the Palaeozoic on the east and the Tertiary beds on the west of the fault is well exposed The Tertiary beds on the west comprise of Kasaulies at the top and Siwaliks below, including upper Siwalik boulder bed On the east of the fault lies the salt-bearing formation termed "Lochan" with the Krol dolomite below The succession of beds is as follows (1) Slate, (2) Trap, (3) Lochan, (4) Dolomite Fault and (5) Siwaliks

Slates — These are widely distributed, and cover most of the area including the mountain Gokhar-ki-Dhar, and are the continuation of Simla Slates and Chail series They are more highly metamorphosed than the Krol series reaching the "epi" metamorphic stage and are composed of silky slates and phyllites The colour is dark grey to green with frequent red stains due to ferruginous matter The general strike is north to south

Trap — This is equivalent of Punjal Trap of Kashmir It is bluish green in colour in contrast to the pink of Lochan It is very much broken up and forms the bulk of the scree on the hillsides The rocks (sp gr, 2 77 to 2 93) appear mottled owing to the alteration of the mineral to delessite A portion, soluble in hydrochloric acid, contains oxides of iron and pyrites Under the microscope is seen a network of felspar and augite crystals set in viridite which in part appears to represent original glossy base. Portions of augite crystals have been altered into brownish-green granular matter Scattered through the mass is white mineral matter, probably leucoxene, a product of alteration of ilmenite

Lochan — This is the salt-bearing formation with a characteristic pink colour representing the leached out portion of salt rock The term Lochan is probably derived from Lokhan Lun and Khan meaning salt mine White powdery spots resembling volcanic ash and angular fragments of dolomite are frequently met with The formation is loose being arenaceous clay and crumbles down when wet This is the chief obstacle for the mining of salt At some places it is about 250' thick The salt occurs at the bottom of the formation and has been proved to be over 100' thick, the average being 70'

Dolomite — The formation is bluish grey to white in colour, hard and compact, sometimes massive and mostly bedded Usually it underlies the Lochan and shows faulted contact with the Siwaliks This is the Krol limestone of Himalayan series, probably Permian in age Pinkish quartzite bands are also frequently met with The Krol series is homotaxial with Shali series The upper portion is composed of cherty massive quartzite and the lower of massive dolomite with layers of chert banded at the base

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Siwaliks — The outcrops of sandstone are well exposed all along the boundary fault, usually in contact with Krol dolomite The top portion is the brownish Kasauli sandstone with middle Siwaliks below The lower Siwaliks are not seen

Age & Origin — The salt occurs sandwiched between the trap rock and Krol dolomite and at some places it is in direct contact with the Tertiaries The salt is always found to the east of the fault line as part of the Palaeozoic rocks The salt and Lochan formation exhibits some special characteristics No bedding planes are visible in Lochan which is one massive structure like the soft marl of the Punjab Salt Range The salt does not show any strike or dip, though occasional striations parallel to the prevailing dip of the associated rocks are seen This points to compression and subsequent metamorphism Earthy matter and angular fragments of calcareous matter are found in the salt which, however, is not associated with gypsum and other salts characteristic of drying oceanic waters White spots resembling volcanic ash are visible in Lochan formation and salt is associated with the Trap All these factors render probable the conjecture that the salt deposition is due to igneous activity The upper carboniferous age is characterized by intense volcanic activity as a result of which we have the Punjal Trap in Kashmir and the Trap rock in Mandi Salt was probably contemporaneous with the Trap and a result of volcanic activity A possible argument against this hypothesis is that due to its fluidity during subsequent folding and overthrusts, it should have been completely squeezed out This very argument may explain the absence of salt elsewhere and the occurrence of suppressed and pinched out lenticular salt masses here The anticlinal structure of the major salt sources lends support to this view The salt occurs below the crest of anticlines at Guma and Darang, the former being asymmetrical

Reserves of Salt — There are vast reserves of rock salt in Mandi which has been worked for the last four centuries All the salt that could be easily worked by open working has been extracted The quarries in the Darang Khad get flooded during rains At Guma it has been worked to the bed of Luni naal There is little further room for quarries at both these sources though Maigal is still amenable to quarrying The reserves are still large and a conservative estimate is about 70 million tons If an igneous extrusive origin of the deposits be accepted, the reserves may be several times this estimate

Quality of Salt — The quality of salt mined in Mandi is poor The average sodium chloride content is 75 per cent in Guma salt and 65 per cent in Darang salt Analytical results of a few samples of salt and brine are given in Table I

TABLE I

	GUMA		DARANG	MAIGAL (Brine salt)
	1st sample	2nd sample		
Sodium chloride	75 62	77 09	62 61	99 01
Sodium nitrate	0 42			
Calcium chloride	0 21			
Calcium sulphate	1 96	0 75	0 49	0 96
Magnesium chloride	5 00		Traces	
Calcium carbonate	5 25	22 14	36 72	
Ferric oxide	0 10			
Insoluble in HCl	10 55			
Insoluble in HF	2 30			
Moisture	0 28			

Salt Sources — Salt has been worked in the past mainly at Guma, Darang and Maigal The average annual production from these sources has been one lakh maunds

Guma — The mine is situated about 7 miles south of Joginder Nagar and 28 miles north of Mandi, left of Luni naal The bed of the gorge and the hill on the left side of the gorge called Hirma Devi are said to be honeycombed with old workings All the salt that could be made available from the bed of the gorge by open working has been extracted Considerable danger attends the mining of salt in this area as the scree is liable to collapse When the author inspected Guma, the mine comprised one tunnel, 5′ in height, which ran through 145′ of debris, with sides and roof supported by wooden props, some of which were giving way At this distance salt was reached and it was being worked in three chambers, two of which had met old workings through which water was flowing into the mine. Chamber No 1 was extended to the west and as a barren hard band appeared in front of the working, a pit about 40′ deep was made wherefrom salt was being excavated The following year the old mine gave way and the salt chambers collapsed after the rains The salt was worked to a limited extent after clearing the debris A drift was started at a distance of about 200′ west of the old entrance to catch the salt in the old mine But as it was not taken in the correct alignment, it met with water from the fault-zone and had to be abandoned If arrangements for draining the water are made, there is no need to abandon further work in the drift Work is being continued by driving a drift at a lower level than that of the present bed of the gorge Adequate provision will have to be made to safeguard the mine from flooding during rains The salt, though massive, shows occasional striations striking south-east to north-west and at places showing a dip of 70° in a direction E 20°N No reliance can, however, be placed on strike and dip The salt occurs under an anticline which is faulted, the fault running along the bed of the gorge from east to west The northern side on the right side of the gorge is the down-throw side and salt has gone much deeper below the surface level

Probably a huge deposit of salt exists under the Hirma Devi Hill and is continuous for a couple of miles to the south-east There is a probability of its continuity for about 15 miles up to Maigal The best position for a new mine is on the roadside near the junction with the Krol dolomite The salt should be proved by putting a number of bore holes in the hill

The best mode of working salt at Guma seems to be by driving bore holes to the bottom of the salt bed and recovering saturated brine for the manufacture of salt In view of the fact that the salt is impure and huge deposits exist, the method of extraction by solution is well suited to the conditions obtaining in Guma The drilling machinery required will be light, as bore holes not exceeding 500′ will have to be driven Ample fresh water supply for this purpose is available locally

Darang — The salt mine is about 11 miles north of Mandi on the left side of Joginder Nagar-Mandi road The high cliffs of pink Lochan beds outcrop over a fairly long distance and are visible from the main road All the salt from the bed of the gorge has been removed by open working and quarrying is no more possible A mine existed at the northern end of the hill but as the management started pumping in fresh water to get saturated brine for manufacture of salt by solar evaporation, the whole mine collapsed in 1943

The Bhatog tunnel was started in 1943, deep in the bed of a nullah on the recommendation of the State Mining Engineer and the approval of Mr E B Lewis, Chief Mining Engineer, Khewra 200′ were dug out in 3 years On inspection in 1946, the author found that the surface cover was only a couple of feet thick and there was danger of the hillside debris coming down The eastern end of the tunnel that had opened up due to the absence of surface cover was destroyed by a landslide in 1947 A new tunnel was started at Buran at the author's recommendation 40′ below the level of the main road to catch the main salt below the cliff and any deposit that may have been left below the west limb of the anticline The progress has been slow and in a year's time only 30′ were reached A good tunnel was also driven at Nagrota but the yield was very small and it was abondoned due to water trouble underground

Darang salt is inferior to that of Guma, and the locality is unsuitable for placing bore holes Judicious mining is the only way to obtain salt in this area and a suitable site can be found below the west side of the main road Although a fair amount of barren ground will have to be traversed, it will pay in the long run A contour map of the area has been prepared (Fig 1)

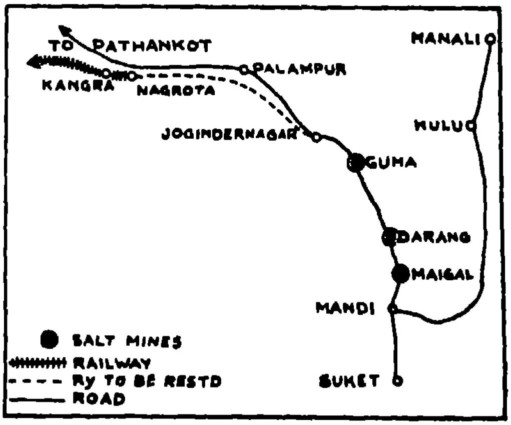

Fig 1 — A map of Mandi showing the disposition of the salt mines

Maigal — This locality is about 5 miles north of Mandi In the northern branch of the nullah, the salt formation runs below the bed of the gorge and there is scope for further quarrying Care has to be taken to preserve this site for systematic mining

Brine springs exist in the other branch of the nullah They are situated about 2 furlongs left of Joginder Nagar-Mandi road The specific gravity of brine is 11°Bé Measurements of rate of flow of brine and its density taken for a period of six months show that the brine does not get diluted during the rainy season even with a considerable increase in flow, the average being 3,000 gal per hr which should be capable of yielding about 1,000 md of salt per day This valuable brine, which has been found to contain 99 per cent sodium chloride, could very profitably be used for the manufacture of salt by solar and/or thermal evaporation

Refinery — A small salt refinery was erected at Mandi on the bank of the Beas river and completed in 1946 The output was only about 150 md per day The refinery was closed down as soon as the salt duty was abolished by the Government of India in 1947 The cost of manufacture was Rs 4 to 5 per md and Khewra salt, after removal of duty, was selling at the rate of about Rs 2/8 per md

Maigal is best situated for erecting a refinery The brine from the springs can be brought down by gravity to the site of the refinery Electricity being cheap in Mandi, the installation of a thermo-compression unit at this spot is recommended With a unit costing Rs 15 lacs and capable of producing 60 tons of white granular salt per day, the cost of manufacture will be Rs 15 to 20 per ton A bigger plant of double the capacity could be erected at Joginder Nagar with the brine supply from Guma The combined output of salt from these sources will meet the requirements of the Punjab and the western districts of the United Provinces

Antioxidants in Science & Industry

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DURING recent years, the subject of antioxidants has attracted a considerable amount of attention Apart from their value in scientific research, in which they represent a new and a vast field, antioxidants play a very vital part in a number of important industries Thus, the success of several of the industries relating to the use of rubber, petroleum and other hydrocarbon oils, fixed oils and fats, essential oils, soaps and cosmetics, paints and varnishes, textile oils, food products, vitamins, pharmaceutical preparations, etc , depends on the use of antioxidants In addition to the rapidly growing scientific literature, there is also a vast amount of patent literature on the subject Several of the applications have only been generally indicated, while many others, which are known to be practised, have not been published or recorded in sufficient detail A review of the progress in such a field presents many difficulties, but an attempt has nevertheless been made in the following pages to indicate generally the scope of the subject and its various practical possibilities

Oxidation — spontaneous and induced — plays a very big part in a variety of chemical processes In some cases where oxidation is necessary to complete the process but is not easily achieved, the presence of small amounts of substances, known as pro-oxidants or positive catalysts, accelerates the action of oxygen In other cases, where oxidation proceeds spontaneously in the presence of atmospheric oxygen, addition of minute amounts of certain materials known as antioxidants or negative catalysts can retard the action of oxygen

Preservation of materials from oxidative deterioration is a very important problem in a chemical industry This is particularly so in the case of rubber, different kinds of fats and oils and food industries Many products are spoiled during storage through want of fortification with suitable preservatives, with the result that the industry loses its reputation and tends to die out The present contribution has been prepared with a view to drawing attention to the importance of the application of antioxidants to materials which are prone to oxidative deterioration

Until about twenty-five years ago, the properties and usefulness of antioxidants were practically unknown to the scientific world Only, since 1922, when Moureu and Dufraisse[1] discovered that traces of certain phenolic compounds like hydroquinone, pyrogallol, etc, when added to auto-oxidizable substances, can prevent their rapid deterioration — a work which subsequently pointed to the commercial possibilities of antioxidants in protecting materials like rubber from destructive oxidation – a vast number of materials have been described in literature as possessing the property of inhibiting oxidative changes According to the application of antioxidants to various industries, they may be broadly discussed under the following heads

Rubber & Rubber-like Materials

The influence of antioxidants on the preservation of natural and synthetic rubber deserves to be first mentioned, because, the progress of the application of antioxidants to various industries originated from their use in preventing the deterioration of rubber

One of the major problems of the rubber industry is the control of " ageing and fatigue " of rubber goods The ageing of rubber becomes manifest in different ways according to the conditions of service and is principally due to oxidation and polymerization The polymers, being rigid and brittle, do not possess the elasticity of rubber and are useless for all practical purposes Metals like copper are well known to exert a marked positive effect on the oxidation of rubber

Considerable progress in the manufacture of rubber goods was made only after it was realized that antioxidants must be used The use of these compounds in rubber industry has been extended from crude rubber to the finished rubber goods Antioxidants for rubber are more commonly known as " anti-agers " and those which have the specific action of preventing catalytic oxidation due to copper in rubber are sometimes marketed as " copper inhibitors "

The practical aspects of the use of antioxidants must be considered in selecting a suitable antioxidant for rubber Apart from having effective age-resisting property, an antioxidant for rubber must satisfy several other conditions as well, viz (1) it must not affect vulcanization of rubber and must not react with the vulcanizing agent used, (2) it must not effloresce the rubber, (3) it must be non-staining and must not produce any undesirable colour in the finished product, and (4) it must not reduce the elasticity which is the fundamental property of rubber and should impart anti-flex-cracking property to it The solubility of the antioxidant in rubber is important in connection with the tendency to " blooming ", the latter being also affected by the state of division of the antioxidant

Instead of following the customary method of incorporating antioxidants in the material of rubber, in some cases the surface application[2] of antioxygen as a solution to the surface of the vulcanized rubber may be an effective method

The rapid increase in the number of new antioxidants available year by year makes it difficult to classify them satisfactorily The development of modern antioxidants is tending towards the use of more and more complex compounds Many of them have been developed empirically and it is not always clear how they function In this field, practical application may be stated to have gone ahead of theory

Recent patents reveal a very marked trend towards complex amines and their numerous complicated derivatives A few illustrations of the direction of these investigations are (a) secondary aromatic amines and their derivatives[3], particularly, derivatives of diarylamines, e g mono-N-methyl diarylamine[4], carbamylamino-diarylamine[5], alkyl-diaryl-amines containing at least 14 C-atoms[6], polyhydroxy or polyalcoxy-diarylamines[7], diamino-diaryl amines and their hydroxy or alkoxy derivatives[8], etc, and (b) tertiary amines[9] Condensation products[10] from amines with ketones have been claimed to possess superior antioxygenic power

Hundreds of patents have been taken on the use of complex phenolic compounds as anti-agers A few of the examples include alkenylamino phenols[11], alkylideneamino phenols[12], octylphenols[13], and ethers thereof The condensation products of phenols with ketones[14], or with simple aliphatic aldehydes[15] have also gained much prominence

Some of the other miscellaneous products which can exert antioxygenic action are amino ethers[16], alkylhydroxyaryl sulphides[17], amino derivative of diphenylene oxide[18], etc

A marked progress in the field of modern antioxidants is revealed in a number of patents[19] which claim improved resistance to ageing of rubber by including in a mixture, in addition to an antioxidant capable of inhibiting atmospheric oxidation, an organic oxygen absorber to eliminate the oxygen present originally in the compound and an organic base non-volatile at the vulcanization temperature and miscible with rubber to activate the oxygen absorber

Some of the antioxidants which can prevent the ageing of rubber can also protect other rubber-like materials like natural and synthetic resins from deterioration As examples may be cited the use of terpene haloalkyl ether-amine condensation products[20] or esters like propyl and secondary amyl p-hydroxyphenyl-amino-acetates[21], etc , to prevent the deterioration of rubber and resins

Hydrocarbon Oils

The mineral oils (commonly known as petroleum oils) and their derivatives, viz fuel oils, gasoline, etc , are prone to be affected through the gradual oxidation and polymerization of the unsaturated hydrocarbons present in them Cracked gasoline, in particular, tends to form gummy and resinous matter, both in storage and in service, which is very objectionable A marked improvement in the gasoline industry was achieved only when the application of antioxidants was started to enhance its resistance to oxidation at elevated temperature and pressure In this connection, it is interesting to note that, under favourable conditions, some antioxidants may also act as knock suppressors[22] and may impart improved anti-knock properties to fuel oils and gasoline

All lubricating oils, particularly the automobile and aircraft lubricants, tend to oxidize while in service with the formation of compounds which are generally of a gummy, resinous, asphaltic and acid character The oxidation products are subsequently deposited in oiling systems as "sludge" The formation of sludge is accelerated by the constant agitation of thin oil films under elevated temperature and pressure and high-speed conditions with air, moisture and solid impurities, especially rust, worn bits of metals and filings, which act as powerful catalysers promoting rapid and substantial oil deterioration

Chemical stability of lubricating oils is a subject of prime importance Improvement in the quality and stability of lubricants has been well achieved by the incorporation of suitable antioxidants in them

A very large number of substances have been recommended as inhibitors for gasoline and lubricating oils The chemical constitution of the antioxidants for these oils are so diverse that a rational and scientific classification is not possible

Some of the antioxidants for rubber are suitable for hydrocarbon oils also, e g alkenylamino phenols[11], alkylideneamino phenols[12], octyl-phenols[13], and ethers thereof, amino-ethers[16], phenol-ketone condensation products[14], etc , exert inhibiting action for hydrocarbon oils also

A few of the other typical antioxidants which have been the subject of modern patents are tertiary alkyl-substituted O-dihydroxybenzenes[23], hydroxyaryl[24] or dialkyl-diphenol[25] sulphides, selenides or tellurides , dialkyl-cyclohexyl[26] or nitroso-alkyl[27] phenols , diamylmercapto-dimethyl ether[28] , N-containing diphenylmethane derivatives[29] , alkali or alkaline earth metal phenoxides formed from high mol wt phenols[30] , N-nitro-aryl-tetra-hydroquinoline compounds[31], polyesters of 12-hydroxystearic or other high mol wt acids[32] , heavy metal salts of the dicapryl ester of di-thio-phosphoric acid[33] , phenol sulphide metal salts[34] , etc

For the prevention of rust formation in bearing materials, the incorporation of single substances or mixtures of compounds of the formula

$$\begin{array}{c} \mathrm{COOR} \\ | \\ \mathrm{COOR} \end{array}$$

(where R stands for hydrogen or an alkyl or aryl radical) with the lubricating oil have been recommended[34a]

For the stability of mineral waxes towards oxidation, the addition of one or more of the following substances at low percentages has been found to be efficacious[34]y

Catechol, thymol, eugenol, guaiacol, hydroquinone, phloroglucinol resorcinol, quinone, pyrocatechol, para-aminophenol, unsymmetrical diphenylhydrazine, mono-benzyl para-aminophenol, dibenzyl-para-aminophenol, alpha-naphthylamine, beta-naphthylamine, phenol, cresylic acid, thymol condensation product with oxymethylene camphor, clove oil and pyrogallol

Patents[35] on the use of mixtures of two or more antioxidants are also becoming increasingly common The importance of the phenomenon of synergism between two or more unrelated substances is now becoming increasingly realized and a large amount of scientific literature is developing on the subject

Antioxidants like aromatic nitrogenous hydroxy compounds[36], reaction products of amines and carbonyl compounds[37], etc , which prevent deterioration of gasoline and other oils when they are in contact with metals like copper, iron or their compounds, which tend to catalyse oxidation, are generally called " deactivators " of the oxidation catalysts

One of the important properties that an antioxidant for hydrocarbon oils must possess is that it should be oil soluble and water insoluble Some simple phenolic compounds like pyrogallol[38], though they are effective inhibitors for cracked gasoline, fail to satisfy other conditions

Fixed Oils & Fats

The glyceride fats and oils which include (a) all vegetable oils and hydrogenated vegetable fats, (b) all animal fats like tallow, lard, butter fat, etc , and (c) marine animal oils, viz fish and liver oils are in general more susceptible to atmospheric oxidation than mineral oils The unsaturated glycerides present in them easily absorb oxygen and the rancidity develops with the characteristic " off odour " and bad taste

The rate and extent of rancidity development are, however, greatly influenced by several factors, viz presence or absence of oxygen, prevailing temperature, exposure to light, the incorporation of certain pro-oxidants like metals and metallic oxides and the presence of free fatty acids Actual continuous exposure to the air is not always necessary Oils produced under usual conditions may contain enough oxygen dissolved in them to bring about oxidation

The fish-oil industry, in particular, is confronted with the problem of rancidity, because fish and liver oils are, in general, highly unsaturated and are, therefore, extremely susceptible to oxidative deterioration

The chemical antioxidants for fats and oils and fatty foodstuffs can be broadly classified as (1) *acid-type inhibitors*, viz several organic and inorganic acids[39] like citric, ortho-phosphoric, etc , (2) *phenolic inhibitors*, viz hydroquinone[40], β-naphtho-quinone[41], di-resorcinyl-quinol[42], pyrogallol[43] and its derivatives like haematoxylin[44], gossypetin[45], etc , gallic acid and alkyl gallates[46], complex derivatives[47] of quinol like hydroxy-chromans including tocopherols, hydroxy-chromans, hydroxy-coumarans, hydroxy-coumarones, etc , pyrocatechol[40a], guaiacol[48], resorcinol[43] and a host of others, (3) *dienols*, viz l-, d- or iso-ascorbic acid[46], ascorbyl mono-esters[49] of fatty acids, and (4) *nitrogenous inhibitors* including aromatic amines[48,50] like phenyl-naphthyl amines, sugar amines[51] and their salts like methyl glucamine and its stearate, and the amino acids[52] like tyrosine, glycine etc , and their esters

The keeping quality of fats and oils is greatly influenced by the nature and proportion of the natural antioxidants present in them Hence, apart from the chemical antioxidants, inhibitors can be isolated and concentrated from natural sources and added to the oils to increase their stability Among the natural antioxidants, cereal flours[53], especially oat flour and their extracts, unsaponifiable fractions[39,54] of vegetable oils, crushed oil-seed cakes[55] and their extracts, crude preparations of carotenoid pigments[56], crude lecithin[39] and cephaline[39], gum-guaiac[57], *kamala* dye[58], etc , have gained prominence Antioxygenic action of certain non-pathogenic bacteria[59] also has been reported

In spite of the great variety of antioxidants reported in literature, it is rather difficult to select a suitable antioxidant for edible products This is so, because, in addition to having superior antioxygenic power, an antioxidant for foodstuffs must satisfy other conditions also *Pharmacological safety*, non-toxicity, sufficient solubility or dispersibility in the medium to which it is added and inertness from the point of view of affecting the normal taste, colour and odour of the treated products are the additional characteristics of an ideal antioxidant for food products

Several workers have shown that a mixture of two antioxidants of different classes is more efficient than either of them individually (*synergetic action*) The synergetic effect is generally achieved by the use of[59] (1) a combination of an antioxidant of phenolic character with an acid-type inhibitor, (2)[60] mixtures including a phosphorus compound like phosphoric acid, a phosphatide or a phospho-protein and a poly-hydroxy benzene or a related compound, (3)[61] mixtures of a sugar with a phenolic antioxidant, (4)[62] a combination of a sugar with a phosphorus compound or (5)[63] ascorbic acid in association with hydroquinones, tocopherols, hydroxychromans, hydroxycoumarans or related compounds Hence, in order to afford maximum protection, it is always desirable to use a mixture of suitable antioxidants

Fat-soluble Vitamins, Carotene, Vitamin Concentrates & Other Vitamin Preparations

The fat-soluble vitamins, particularly vitamins A and E, are very unstable and easily susceptible to oxidation Vitamin D is comparatively more stable than vitamin A

A good deal of work has been done on the stabilization of vitamin A in ghee[45,58] and in liver oils[46a,64,58c.] It has been reported[58c,65] that the development of oxidative rancidity and the destruction of vitamin A in fats and oils proceed simultaneously and antioxidants which prevent rancidity in oils can usually protect the vitamin present in them

In a tropical country like India, the liver oils and the vitamin concentrates lose their vitamin A potency on storage at a comparatively rapid rate During recent years, considerable attention has been drawn to the stabilization of vitamin A in shark liver oil The vitamin in the oils, as now marketed, however, tends to deteriorate on keeping It must be preserved with the help of suitable antioxidants if the industry is to continue to flourish in the face of intense foreign competition The use[65a,66] of an alkyl gallate, especially ethyl or iso-butyl gallate, in conjunction with citric or tartaric acid has been reported to have beneficial effect on the stabilization of vitamin A in shark liver oils of low acidity. The use of haematoxylin[44] as an antioxidant for carotene, vitamin A, etc, has been patented.

It should be noted, however, that antioxidants which can prevent the oxidative deterioration of vitamin A in ghee or in liver oils fail to exert their antioxygenic power against the destructive action of sunlight[67,66a] Hence, in order to preserve vitamin A, great care should be taken to avoid unnecessary exposure to sunlight

Vitamin C

Vitamin C also is very unstable and spontaneously oxidizes when exposed to atmospheric conditions The prevention of the rapid destruction of ascorbic acid in fruits on storage is an important problem which has to be systematically investigated What little work has been done on finding out a non-toxic antioxidant for vitamin C records that *d*-iso-ascorbic acid[68] appears to be a potent antioxidant for retarding the oxidative changes of *l*-ascorbic acid (vitamin C) Thio-urea[69] exercises a powerful stabilizing action against catalytic destruction by copper and hence has been suggested as a commercial antioxidant for vitamin C The protective action of pyrophosphate[70] against atmospheric oxidation of vitamin C even in presence of copper has been reported A few other antioxidants which also are effective to some extent are creatinine[69], glutamic acid[69], etc A good deal of further research remains to be carried out in this field

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(To be continued)

REVIEWS

Scientific Terminologies in Anglo-Indian Languages, An English Gujarati Glossary of Scientific Terms in Nagri Script compiled by P G Shah I A A S (Retd) (Gujarat Research Society Bombay) 1949 pp lvi + 200 9½″ × 6¼″ Price Rs 6

A PROBLEM OF OUTSTANDING IMPORTANCE today for the progress of science and general culture in India is the place of 6 or 7 principal Indian languages in these pursuits in future *vis à vis* English that has been adopted by India for the last eight or nine decades The question is whether the tempo of progress attained during this period of at least 20 30 millions of our people in science and culture will be maintained or re enforced or retarded by a change over from English which has so far served as the medium of communication between the provinces of India and with the world at large to the chief languages of the provinces English has been *par excellence* the language of science commerce law and of matters pertaining to politics and economics above parochial or provincial level and as such has satisfactorily performed these various functions in the national life of India It has thus been instrumental in raising the status of India The chief draw back of English however is that it is likely to remain always the language of the intelligentsia barely 10 per cent of the population of the country For this and several other considerations a section of the people are demanding — and demanding somewhat impatiently — the replacement of English by the more developed of the provincial languages (Hindi Bengali Tamil Gujarati Marathi Kanarese and one or two others) in all departments of public life on the ground that a rich language like Sanskrit is fully capable of supplying vocabularies as rich comprehensive precise and flexible That Sanskrit and many provincial languages which are daughters of Sanskrit are capable of this no one doubts the doubt most frequently expressed is whether a completely new mintage of glossaries and vocabularies in scientific and educational subjects will serve the needs of the country better in the present stage of its development Is it possible that this experiment in individualism after India s plunge in internationalism of the last few decades since World War I will accelerate the progress of the present and future generations in science education invention international commerce industry?

The general consensus of opinion from experience gathered so far seems to be that while workable and systematic vocabularies should be made for most branches of science and trade in order to enable our primary and secondary schools to begin imparting knowledge through the vernacular medium no universally accepted system or plan for the framing of the new terminologies in the diverse languages of the country yet exists It is a fact that several elaborate well directed and praiseworthy attempts for producing comprehensive English Indian dictionaries and glossaries in science law education etc in at least 5 languages sponsored by learned societies universities or by individual scholars have failed to satisfy educated professional opinion or to create a popular demand for further attempts along similar lines

Serious attention of our educationists and legislators has yet to be focussed on this question of choice of language for instruction of our youth especially in science technology and higher research for on the right approach to this problem will depend largely the march of the nation along the road to enlightenment

In this state of indecision of popular opinion the appearance of a modest work on an English Gujarati glossary of scientific terms is very welcome Unpretentious in size and in its immediate objective it expounds sound principles for building of more comprehensive scientific dictionaries in Anglo Indian languages In its preface the author Mr P G Shah C I E a devoted scholar who has rendered splendid service during the last 25 years in the cause of scientific and cultural development in Gujarat reviews the history of previous efforts in Urdu Marathi Gujarati Hindi and of official efforts in this direction In a sober objective essay he discusses the disadvantages and undesirability of adopting a uniform, brand new scientific terminology for all Indian languages, the international aspects of the question, the profound reflections of Mahatma Gandhi on this theme and the suggestions made on various occasions by Pandit Jawahar Lal Nehru He then suggests 14 working rules which should guide the framing of satisfactory systems of scientific terminologies in the principal provincial languages for the use of secondary schools which are sooner or later to begin teaching through the mother-tongue , for the self-instructing adults and persons of the working classes anxious to acquire knowledge of modern science , and for the popular writers on scientific subjects in the newspapers, periodicals and science primers in different Indian languages

The scientific glossary proper covers exactly 200 pages of the book, including the most common terms used in the physical and biological sciences, medicine, astronomy, mathematics, geology, economics and philosophy Equivalents of these standard terms in Gujarati are given in the Nagri script In the reviewer's opinion, the chief feature of the present work lies in the admirable sense of judgement displayed in selecting apt expressive and suggestive Gujarati equivalents for the standard scientific terms, thus encouraging the reader and learner in his desire to acquire more and more scientific vocabulary in his own language and the avoidance of hard, far-fetched and unfamiliar Sanskritized words and phrases The use of Nagri script is thoughtful , with a very little change in the grammatic terminations of Gujarati words, the glossary can be adopted for a far larger circle of Hindi users In this sense the present compilation may be considered as a preliminary to a much larger lexicon of Anglo-Hindi scientific terms encompassing a wider field of more advanced sciences, technology, engineering, etc The author advocates the adoption of what may be called " international " terms and constants without change, but is rightly against replacing of old Hindi or Sanskrit words of established usage in astronomy, mathematics, medicine, astrology, etc In general his view is that premature finality and rigidity aimed at by some new systems of nomenclature will do harm, but that they should grow round a nucleus of existing vernacular terms that are current, well understood and have the sanction of long usage The author has had the benefit of consultation and collaboration with a number of Indian scientists On the whole, the scope and distribution of standard terms, constants, symbols and units of the different sciences show balance and judgement, save in one science which has a disproportionate plethora of common words and phrases A few striking omissions of terms, especially the nomenclature employed for the borderline sciences, are noticeable These minor defects are easily remediable in a new edition which, there is no doubt, will soon be called for

The printing, format and general get-up of the book is attractive and gives credit to the Gujarat Research Society, Bombay, who are the publishers

D N WADIA

Colloid Science II. Reversible Systems, Edited by H R Kruyt (Elsevier Publishing Co Inc , New York), 1949, pp xix + 753 Price 77*s* 6*d*

THIS MONOGRAPH IS THE RESULT OF A CO-operative effort of a number of specialists and deals with the reversible colloidal systems which have acquired importance consequent on the development of synthetic macromolecules The thermodynamical aspect has been treated by J J Hermans, with special reference to vapour pressure, osmotic pressure, swelling pressure and heat of mixing The same author has also written the chapter dealing with physical properties in solution such as optical anisotropy, dipole moments, sedimentation velocity, time of relaxation, viscosity, flow birefringence as well as the properties in the solid state such as elasticity, swelling and double refraction on stretching A complete chapter on the important subject of determination of molecular weights has been written out by J J Hermans and P H Hermans. J Th G Overbeek and H G Bungenberg de Jong have written the chapter on macromolecular electrolytes One full chapter on reversal of charge and three chapters on the different aspects of coacervation have been written by Bungenberg de Jong P H Hermans's chapter on gels deals with sol-gel transformation, structure of gels and sorption by gels There is one chapter by Houwink dealing with solid macromolecular systems. The last chapter by H. L. Booij deals with association colloids as represented by soaps and dyestuffs.

The book is, on the whole, well written. By way of exceptions a few minor errors may be pointed out: (1) sub-section letterings on page 42 do not correspond with what is given in contents. Similar errors are to be seen on pages 36 and 38. The name of the author of the last chapter is differently spelt on page viii (Booy). In equation (1) on page 50, it is desirable to specify the conditions under which the different partial differential equations hold. While treating hysterisis in sorption, a reference to the early concept of McBain, which has been established by recent experimental work, would have been useful.

The book forms a good guide to the domain of macromolecules and provides an excellent stimulus for research in the field.

K. S. GURURAJA DOSS

Making Conference Programs Work, by M. F. Stigers (McGraw-Hill Book Co. Inc.), 1949, pp. 256. Price $ 3.50

THIS BOOK IS ONE OF A SERIES OF PUBLICATIONS on industrial organization and management published by McGraw-Hill Book Co. Conferences play a very important part in the American way of life, especially in their large industrial concerns and educational institutions. The author, who is an Associate Professor of Trade and Industrial Education in Purdue University, is well fitted for the task of writing a textbook on the technique of conferences, since he has himself taken a leading part in several such conferences. The observations in the book are born of real and valuable experience gained through several years.

In large industrial concerns consisting of several departments, it is frequently necessary to hold meetings between representatives of the various sections to exchange ideas on common problems, to evolve methods of improving production, both in quality and quantity, to discuss questions of personnel, etc. In big educational institutions also it has been found useful to have such meetings between the various members of the staff to discuss questions about training students. The method of settling questions and evolving procedures by conferences need not be confined to these two fields and can really be extended to several other fields of group activity.

Mr Stigers discusses in detail the types of conferences, the physical arrangements necessary for such conferences, the preliminary steps necessary before the beginning of a conference, the way in which the programme of the conference must be drawn up, and the technique and etiquette of a conference. He has concentrated his attention on two important aspects of conferences: (1) the rôle to be played by the conference leader and (2) the method of getting the best results out of such conferences. He has also given in the latter part of the book actual examples of conference programmes in industry and selected conference reports.

It may, at the first blush, appear as if such a book will be of no use to us in India. But nothing would be farther from truth. India is very often the venue of international meetings of the various bodies attached to the U.N.O. Indians have to take part in many conferences abroad. A clear knowledge of the conference technique would be extremely useful to these representatives. Moreover, in many of our big institutions like the Council of Scientific & Industrial Research, the various Departments of the Government, the Tariff Board, etc., a lot of work is carried out in conferences though the word "conference" itself does not figure in the reports. People are invited from distant parts of the country, public money and valuable time are spent on such meetings. At the end of many of these meetings, the members come out with a feeling of futility about the usefulness of such conferences. Very often there is no specific programme before the meeting and the members come entirely unprepared and without forethought. The result is that various loose observations are made and the meeting ends without achieving any result. Mr Stigers has rightly stressed the necessity of drawing up a proper programme beforehand and specifying the particular problems to be discussed so that the members can think over these problems and come to the meeting with their considered views. Sometimes the leader of the conference "misbehaves", loses his temper with his colleagues, interferes too often in the normal smooth working of the meeting or tries to impose his own views on others. Sometimes after the meeting is over, a biassed report about the decisions arrived at in the meeting is circulated by the leader as an authentic account of the conference A careful study of Mr Stigers's book will show how to avoid such pitfalls and how to utilize conferences in the best manner possible

Terrestrial Radio Waves, by H Bremmer (Elsevier Publishing Co Inc, New York, Amsterdam, London, Brussels), 1949, pp x + 344 Price $6 75

THE MAIN OBJECT OF THE BOOK HAS BEEN the analysis of the mathematical-physical methods for computation of fields due to a radio transmitter After giving a general introduction, the author divides the subject-matter of the book into two distinct parts The first — chapters II to VI — deals with a homogeneous atmosphere and estimation of ground-wave field, the conditions for finite heights of transmitter and receiver being, of course, fully discussed The second part — chapters VII to XI — is devoted to the theory for an inhomogeneous atmosphere including the ionosphere and the troposphere

The author begins chapter II with the expression for the ground wave in the form of a series of zonal harmonics Chapter III deals with Watson's transformation and its further modification for numerical solution, specially for radio problems The total radio field due to primary and directly reflected components is expressed as a series which is dealt with by two distinct methods — the method of residue series having the characteristics of diffraction theories and the saddle point or geometric-optical method The residue series is elaborated in chapter III and its applications are further discussed in chapter IV Firstly, the field is computed when both the transmitter and the receiver are on the earth and the limitations of the formula for short distances are pointed out The relationship between the values from the residue and those from Sommerfeld's solution for the flat earth is certainly interesting For computation of fields when transmitter and receiver are above the earth's surface, height-gain factors are introduced which make numerical computations lengthy These are discussed in great detail Chapter V deals with geometric-optical approximation with the aid of the saddle-point method It is pointed out that this method is applicable precisely in the region where the series of residues fails owing to its slow convergence The field by this method differs from the familiar expressions by the presence of a "divergence coefficient" and also by the Fresnel reflection coefficient being replaced by spherical reflection coefficient The author has, of course, pointed out that for all practical purposes the Fresnel coefficient may be used without appreciable errors

Although the discussions are characterized by mathematical rigour, the engineering applications of the complicated formulae have not been overlooked A survey of the formulae required for numerical calculations, as also many typical results, are presented in the form of graphs in chapter VI Propagation conditions over ground and sea have been dealt with separately but the important problem of transmission over a composite path of both land and sea has not been studied seriously

Part II of the book is devoted to an inhomogeneous but spherically symmetrical atmosphere, comprising both the ionosphere and the troposphere In chapter VII the general nature of the variations of the index of refraction is discussed and the geometric-optical behaviour of wave propagation as also a theory based on wave equations are given The different components of the total field in presence of ionosphere are discussed in detail in chapter VIII, firstly neglecting absorption and then extending the method for non-negligible absorption The discussions on the field in the neighbourhood of the skip distance and also at the antipode are very interesting

Chapter IX deals with the residue method for the sky wave and the relationship between it and the geometric-optical methods as also their respective fields of application Probable models of ionospheric layers and also for the troposphere for microwaves are discussed in chapter X Propagation of long and short waves and corresponding numerical computations are then discussed in detail The theory of super-refraction is also treated at some length on both the methods The trajectories of cosmic radio waves arriving at the earth are considered at the end of the chapter

The concluding chapter XI is devoted to the effect of the earth's magnetic field Conditions for a homogeneous space, applicable for long waves, are first considered, followed by estimates of reflection coefficient and electric field for typical cases The conditions for slowly varying anisotropic non-absorbing ionosphere, applicable to short waves, are then taken up The ray theory has been adopted except in cases where it ceases to hold good There is no reference to the recent wave treatments of the problem by Saha and his school

Throughout the book the treatment of the different topics has been made with mathematical rigidity, but at the same time the approximate solutions for conditions usually met with in practice have been pointed out Being fundamentally a mathematical treatment, it will perhaps not appeal very much to the average radio engineer who will undoubtedly find it difficult to follow The many numerical computations will, however, be of great interest A serious student of radio wave propagation will find the book extremely useful

H RAKSHIT

Technique of Radio Design, by E E Zepler (Chapman & Hall Ltd , London), 1949, pp 394 Price 25s

THE SECOND EDITION OF THE " TECHNIQUE of Radio Design " is in every way as useful to the radio designer of any developmental or research laboratory as the first edition There are many excellent text-books dealing with the general principles of circuit design but scarcely any of a practical nature The author, based on his years of experience as head of the Receiver Development Department of Telefunken Works, has presented a book which deals with practical problems facing a radio designer confronted with building a workable apparatus

The treatment is accurate and is supplemented by the inclusion of numerous example which give practical values to the constants so that the dimensions of the problem can be readily assessed, specially by inexperienced design engineers

The chapters are well arranged following the signal from aerial to loudspeaker and deal with the appropriate portions of the receiver

In the second edition chapter 3 has been considerably enlarged — specially the section dealing with "Negative Feed Back" Chapter 6 on " Receiver Noise " has 10 additional pages to include the large amount of data accumulated during the last few years Chapter 9 on " Undesired Feed Back " is much more exhaustive On page 309, the portion dealing with " Incorrect Earth Connections " is a useful addition Pages 318 and 319, paras B and C, under " Spurious Beats " are very good On page 375 the para on " Noise Factor " is additional

This book is a " must " to every radio designer It suggests methods and presents data of practical design which can otherwise only be acquired slowly by experience

T V RAMAMURTI

Selective Toxicity and Antibiotics, Symposia of the Society for Experimental Biology (Macmillan & Co Ltd , London), 1949, pp vii + 372 Price 35s

THE VOLUME UNDER REVIEW IS A RECORD of the " Symposium on Selective Toxicity and Antibiotics " held in Edinburough in July 1948

The term " selective toxicity " is a very terse one which indicates the general way in which the drugs, disinfectants, antiseptics, insecticides, etc , produce the particular effect they are noted for When such an agent is introduced into a system, it attacks some centres (causes toxicity locally) in preference to others The precise mechanism, the " why " and " how " of this effect, is now sought to be elucidated so that on the basis of this knowledge we can consciously design and produce the agents we require to control diseases, pests, etc This subject is an extensive one and requires to be studied from various angles employing different sciences and disciplines Records of such attempts made in U K are found in this volume in the form of twenty-two essays dealing with various topics Each essay is not a mere compendium but a critical evaluation of the work done by the author or the knowledge in the subject Some well-known names are missing in this volume, but fortunately their views have been recorded elsewhere It would be impossible to deal with them and record the reviewer's opinion about them in the space available To give an idea of the coverage of the symposium, we can just enumerate the headings in the order given in the book organic chemists' approach to chemotherapy, the differential activity of certain anti-malarial agents against protozoa and bacteria, the study of enzymes in relation to selective toxicity in animal tissues the design of bacterial inhibitors modelled on essential metabolites antibiotics derived from *B polymyxa* the resin of hops as antibiotics systematic insecticidal properties induced in plants by treatment with fluorine and phosphorus compounds surface activity and permeability as factors in drug action the permeability of insect cuticle selectivity of drug action in protozoal blood infections aspects of the selective toxicity of sulphonamides and their antimetabolic inhibition the effect of long chain fatty acids on the growth of *H pertussis* and other organisms the effect of unsaturated fatty acids on gram positive bacteria the action of penicillin on the assimilation and utilization of amino acids by gram positive bacteria adaptation of bacteria to resist drug action the significance of hydrogen ion concentration in the study of toxicity the effect of phenyl carbamates on the growth of higher plants the comparative toxicity of phytocidal substances therapeutic interferance some effects of diet on toxicity — the influence of diet on the induction and inhibition of tumours external metabolites and ecological adaptation and the production of antibiotics by micro organisms in relation to biological equilibria in soil The reviewer has enjoyed reading every line of all these at a breathless pace

Useful technical books can from the pragmatic point of view be divided into two classes The first class comprise those which are authentic catalogues of facts in a subject that has taken some shape These are reference books they serve as aids to memory and come in handy to get at the previous knowledge in a subject in the shortest time possible The second class of books is not at all valued for the above Their important function is to generate ideas for further work to serve as an intellectual ferment or to act as a midwife to bring out ideas in the womb The volume under review belongs to this class and is sure to fulfil its function The secretaries are to be congratulated for having brought out this volume and broadcast this symposium held in Edinborough to a much wider audience

There are two complaints to make The symposium was held in July 1948 but the volume reached the reviewer s hand only in January 1950 Secondly though the printing and get up of the book are very good the cost of the book is almost prohibitive for the researchers to possess The usefulness of a good book like that of a drug is assured only when it reaches the sites where its action is desired This applies to all technical books now being published We should now seriously think about ways and means of bringing such books within the reach of all the researchers In the present case the I C I could have contributed a little more and thus brought down the cost of the book considerably

K GANAPATHI

A Theoretical Investigation into Some Properties of Ionic Crystals, by Per Olov Lowdin (Uppsala University Thesis published by Almqvist & Wiksells Uppsala)

THIS IS A VALUABLE INVESTIGATION OF THE properties of ionic crystals of the NaCl type based on quantum mechanics The thesis is divided into two parts The first deals with the cohesive energy of a system of ions having complete electron shells ignoring thermal agitation An expression for the energy is found in terms of one electron wave functions The electrostatic energy is regarded as made of two parts i e the Madelung one and the coulomb correction due to the overlapping of the ions A formula for the exchange energy for a pair of ions is found The S energy depending on the non orthogonality of the free ion wave functions is also found out The sum of these three energies gives the cohesive energy In the second part of the thesis applications of the formulae have been made for crystals of the NaCl type The wave functions of the negative ions F and Cl and the positive ions Li^+ Na^+ K^+ are found Numerical calculations of the cohesive energy the inter ionic distance and the elastic constants of the ionic crystals have been made The agreement between the theoretical and experimental results is good in the case of NaCl KCl and NaF while discrepancies exist in the case of LiCl and LiF But one must say that the theoretical results obtained form an achievement because they do not assume any experimental values except the values of the fundamental constants The thesis will be a very valuable guide to those who would wish to pursue the matter further and it is indeed a praiseworthy investigation

N S NAGENDRA NATH

The Indian Science Congress Association

THE ANNUAL REPORT OF THE EXECUTIVE Committee of the Indian Science Congress Association for the year 1949 records satisfactory progress in all its activities Several members and office-bearers of the Association were invited by the Government of India to work in a number of expert committees to advise the Government on various developmental schemes and projects Two important delegations one to the U N Conference on Natural Resources held at New York and another to Australia, were sent by the Government of India and in both these delegations members of the Indian Science Congress Association played a prominent rôle The Association received recognition from many foreign scientific bodies, notably the British Association for the Advancement of Science and the Institute of Physics and Physical Chemistry, Israel Members of the Association were also represented on the Indian National Commission for Co-operation with the UNESCO and the Defence Science Conference organized during the year A Sub-committee of the Association was appointed to report on the development of the Andaman and Nicobar Islands The Sub-committee on UNESCO has undertaken to prepare and submit reports on the following subjects Means of extending collaboration between the Association for the Advancement of Science, the science club movement popularization of science through cheap books and book clubs and the interaction between science and society A special symposium on Application of Science in India for Social Welfare ' was held at the Allahabad University under the auspices of the Sub-committee for Science and Its Social Problems '

On the suggestions of Prof A D Ross Chairman of the Australian National Research Council, the Executive Committee approved the idea of holding the Pan Indian Ocean Science Congress on the lines of the Pan Pacific Ocean Science Congress The session, which is to be devoted to discussion of scientific and technological problems peculiar to this zone and to furthering the cause of international science is to be held immediately after the 1951 session of the Indian Science Congress at Calcutta

To facilitate the editing of scientific papers and preparation of abstracts a set of instructions on editorial guidance for papers has been prepared with the co operation of Mr J Coates, President of the Section of Geology, 1949 50, of the Association

In order to strengthen its membership, the Executive Committee has issued a pamphlet which seeks to popularize the aims and objects of the Association

The question of building a permanent headquarter for the accommodation of all scientific bodies with their head offices in Calcutta on the lines of the Burlington House in London, is being studied and details are being worked out

The budget estimates of the Association for the year show considerable increase in expenditure which has been balanced as a result of a grant of Rs 15,000 from the Government of India The Committee have strongly urged the desirability of increasing its membership subscription from Rs 12 to Rs 15

RIVER RESEARCH IN WEST BENGAL

INVESTIGATIONS ON MODELS, ANALYSIS OF SOIL FOR the construction of dams and barrages proposed under the Mor (Mourakshi) Project and the Ganga Barrage Scheme formed the main part of the research work carried out at the River Research Institute, West Bengal, during the year 1948 Besides these, investigations were also undertaken for the Damodar Valley Corporation and the Assam Railway

A new site 1000′ downstream of the site proposed originally, has been recommended for the barrage over the Kopai river as a result of model investigations Hydrological observations of the river Mor have been carried out at a number of points Samples of soil from an area under the Messenjore Dam site have been analysed for their suitability in dam construction Results show that whereas shell material is ample in the vicinity, enough core material is not available The soil in this area covered by the Mor Project has been found to be porous and likely to produce water logging at low places under perennial irrigation unless proper drainage is provided

The investigations conducted under the Ganga Barrage Scheme aims at the construction of a barrage across the river Ganga to supply silt-free water into the Bhagirathi-Hooghly to maintain a navigable channel all the year round from Calcutta to the Ganga and to combine a road and railway bridge with this barrage Gauge and discharge observations and analysis of silt samples collected from the river Ganga at Faracca, estimation of the minimum discharge necessary to maintain the Bhagirathi in a navigable condition indicate that discharge of 12 000 to 13 000 cusecs will maintain a 160′ wide and 9′ deep channel if a few stretches are resectioned

Other investigations have been concerned with spill operations necessary to maintain the Tolly's Nullah (channel) in proper condition, methods of reducing scour in the Peechaboni Khal (channel) upstream of the tidal slice, analysis of the sewage water from the sedimentation tank at Bantalla to determine the efficiency of sedimentation, analysis of gauge discharge and silt samples from various sites on the rivers Darakeswar and Selye for construction of dams in the upper reaches of the rivers, hydrological observations of Kalighai river system to prevent floods into Kalighai river valley and run off and soil erosion experiments at Arabari

The work undertaken for the Damodar Valley Corporation related to hydrological observations of the river Damodar and its tributaries and analyses of soil and water from Damodar river

HYDRAULIC & IRRIGATION ENGINEERING RESEARCH IN HYDERABAD

PROBLEMS CONNECTED WITH THE DESIGN AND construction of spillways, weirs channels and causeways were successfully tackled and interesting results were obtained in analytical studies and insulation tests conducted on various engineering materials at the Engineering Research Laboratories, Hyderabad, during the year

In the Hydraulics, Irrigation and Hydraulic Machinery Section, investigations were continued on the problem of designing a profile for a spillway for Manair Irrigation Project A suitable design duly tested on a scale model with regard to coefficients and pressures was recommended to the Executive Engineer Methods have been devised to reduce the inflow of sand into Polkampalli river and ensure the requisite flow of water into it from Kapeta river The rivers meet and separate after 7 chains to meet again a few miles downstream On the right branch after separation an anicut (weir) and sluice have been constructed to supply water to the canal feeding several tanks Earlier devices to direct the water into Polkampalli river by constructing first an earthen bank and later a weir across the left branch had failed

Experiments have been conducted on two models of a tail-race channel proposed to be led parallel to the Nizamsagar canal This canal has a full supply discharge of 3,400 cusecs and has 3 drops within the first 34 chains from the head sluice the total drop amounting to 32′ A scheme for utilizing this drop for production of power has been sanctioned

An investigation was made into the failure of the high-level causeway across Pedda river in Medak district It is suggested that modifications that tend to increase the coefficient of discharge of the structure as a whole and so reduce the afflux and depth and flow over the crest during floods may be adopted It is emphasized that in designing causeways across jungle streams bringing in a lot of brushwood during floods, the calculation for stability, high flood levels and afflux should be based on the supposition that all the vents are likely to be blocked during heavy floods The fact that the high flood level recorded in this particular case is above the designed high flood level does not show that the flood is greater than that for which the causeway was designed Due to the partial blocking of the vents, the depth of flow over the causeway crest is increased, thus increasing the high flood level above the designed level even at lower flood intensities On this basis a number of recommendations have been made for reconstructing this and other high level causeways of the type

In the Soil Mechanics Laboratory, about 70 soil samples were analysed and tested for roads canal linings, rammed earth buildings, manufacture of bricks and *surkhi*-mortar including 8 samples of aggregate for Nizamsagar Hydro-electric Scheme Traffic census have been conducted on different types of wearing courses and their behaviours observed under the same intensity of traffic

Laboratory tests were made to determine whether cement stabilized soil in the form of bricks, slabs or blocks could be used for lining canals to reduce seepage losses and economize in earth work by providing for greater velocities Test results of 3 soil samples which were found satisfactory are given

The possibilities of replacing lead with steel and concrete of relative density 2 4 in a room meant for installing a Maximar 250 deep X ray therapy unit have been examined The use of aggregates of higher specific gravity and higher unit weight, and selection of the grading of aggregates for maximum unit weight is considered to give a concrete of density 2 4 Specifications of materials with their proportions for the required cement-concrete mix are given

Studies of cheap insulants for roofing materials to improve their thermal characteristics were made and a model house with country tiled roof registered lower maximum temperature and higher minimum temperature than in shade The model has with corrugated iron and asbestos cement sheet roofs, recorded maximum temperature higher than that of shade In summer, maximum temperature recorded by country tile roof was lowest, corrugated iron roof coming next with asbestos cement roof recording the highest temperature A study of variation in maximum temperatures at various depths below the roof level has been made The average daily maximum temperature at any particular position has been found to decrease with the increase in its depth from the centre of the roof The decrease is greater in summer than in winter

INDIAN MATHEMATICAL SOCIETY

THE SIXTEENTH CONFERENCE OF THE INDIAN Mathematical Society was held in Madras from 26th to 28th December 1949 About 30 papers covering topics on modern algebra and abstract spaces theory of numbers analysis geometry, astronomy and statistics were presented There were symposia on ' Recent Developments in Harmonic Analysis ', "Time Series Analysis", "Fluid Mechanics and Teaching of Mathematics " A feature of the Conference was an interesting mathematical exhibition at which models relating to geometrical surfaces and solids, topology, astronomy statistical charts and photo-print copies of Ramanujan s notebooks were presented A well got-up souvenir prepared in connection with the Conference contains interesting articles about the origin and development of the Indian Mathematical Society Ramanujan and contributions to mathematical thought from South India, besides an illustrated account of the historical and cultural background of Madras

NOTES & NEWS

Lipophilic Chemotherapeuticals

A NUMBER OF POSSIBLE LIPOPHILIC chemotherapeuticals of the sulphonamide and sulphone series and 2-sulphanilamido-thiozolones have been synthesized and investigated for their possible activity against tubercle bacilli both *in vitro* and *in vivo* (*Proc Indian Acad Sci*, 1950, **31**, 21)

Among the compounds of the sulphonamide and sulphone series synthesized are the hydnocarpic acid derivatives of N^4-*n* fatty acyl sulphanilamides, N^4, N^1-dihydnocarpylsulphanilamides, normal fatty acyl derivatives of 4-nitro-4-amino and 4 4-diamino diphenylsulphones, 4 4-*bis*-adiphlamido-and 4 4-sebacylamido-diphenylsulphones and the N^4-*n*-caproyl derivatives of 2-sulphanilamidopyrimidine, 2-sulphanilamido-4-methyl and 2-sulphanilamido-4 6-dimethyl pyrimidines

In the sulphanilamidothiazolones group, a method for the preparation of the intermediate 2-amino-5-substituted thiazolones starting with the corresponding mono- and dibasic fatty acids has been worked out New 5-substituted pseudothiohydnantoins derived from monobasic acids, viz 5-*iso* propyl-, 5-n-hexyl-, 5-n-tetradecyl-, and 5-phenyl-2-aminothiazolones 5 5′ ethylene-*bis*-2 2-aminothiozolone and 5 5-hexamethylene-*bis*-2 2-aminothiazolone are among the new members derived from adipic and sebacic acids respectively A number of sulphonamidothiazolones have also been synthesized

2-sulphanilamido 5 ethylthiazolone differs in its physical characteristics from those of the sulphaethylthiazolone reported by earlier workers and has been found to be markedly active in some acute bacterial infections

Synthesis of Citrinin

A SIMPLER SYNTHESIS OF CITRININ which has interesting possibilities for synthesis in the isochromane is described (*Curr Sci*, 1950, 19, 20)

4 methyl-resorcinol-2-carboxylic acid-5 ethyl methyl carbinol is treated at room temperature (28°-30°C) with about 10 times its weight of ethyl orthoformate Crystalline citrinin separates rapidly from the yellow solution After 30 min, crushed ice is added and the yellow needles of citrinin are filtered, washed and dried The m p (171 5° dec) is undepressed by admixture with natural citrinin and the yield is almost quantitative

Vitamin B_{12} Concentrate

A quick method of obtaining Vitamin B_{12} concentrates from commercial sources making use of the relationship between the colour of the concentrate and its potency is described (*Science*, 1950, **110**, 528)

0 5 c c of liver injection, *USP* (Lederle solution extract from leaf liver, 154 per c c) was dried and 0 1 c c of *N* HCl added to the residue followed by 0 5 c c of a mixture consisting of 0 1 *N* HCl, *n*-propanol, and *n* butanol in the proportions of 1 2 1 The solution when chromatographed on 25 gm starch in a 10 mm × 300 mm column with the 1 2 1 mixture as solvent yielded the following fractions having different activity 4 2 c c colourless, 1 8 c c slightly coloured, 80 m u, 1 8 c c, slightly coloured, 240 m u As colour is an index of the potency, it is easy to know what portion of the effluent to collect

Aluminium-silicon Alloys

PRODUCTION OF ALUMINIUM-SILICON alloys by thermo-electric methods developed in Germany together with the working of Lurgie-Thermie Factory at Horrum, Rhine, are described in the *BIOS* final Report No 253

In this process impure aluminium silicon alloys containing 40 to 60 per cent silicon produced by electrothermic means are later refined to purer forms of " silumin " (containing 5 to 20 per cent silicon, not more than 2 per cent of other metals and the rest aluminium) by diluting them by pure aluminium so as to give a final alloy containing 11 per cent silicon The raw materials, alumina, wood charcoal, china clay, quartz and possibly manganese dioxide, are fed through a mixer with the addition of water to a drum-type briquetting machine which gives flattened, egg-shaped briquettes The proportion of the ingredients is suitably adjusted according to whether the primary alloy to be produced is 60 per cent or 40 per cent silicon alloy

The reduction is carried out in single-phase A C arc furnaces The consumption of electrode is 16 per cent on the weight of the alloy produced The furnace is a stout steel cylinder with " cathode " connections to one side Power is supplied by separate transformers for each furnace on which the load averages 650 kW The briquettes are charged into the furnace until it is full and liquid metal is tapped off The process is continuous with an efficiency of 95 per cent and the power consumption is about 1,520 kWh per ton The crude metal tapped containing 95 per cent aluminium and silicon, is taken to electric refining furnaces of the tilting crucible type where slag is removed under a flux composed of 6 parts of common salt and 1 part of cryolite The refined alloy is then melted in gas-fired tubular furnaces Other primary metals are added to yield a wide variety of final alloys (*Production of Aluminium-silicon Alloys* Literature Report No 4, by B S Srikantiah and B R Nijhawan, National Metallurgical Laboratory, Jamshedpur)

Electrolytic Descaling

A SIMULTANEOUS DESCALING AND tin-plating electrolytic process is described (*Chem Age*, 1950, **62**, 21)

The operations include degreasing, rinsing, descaling and final wash Degreasing is accomplished anodically using a highly alkaline cleaner The scale and oxide are removed cathodically in a bath containing dilute sulphuric acid, a small concentration of tin salt and an addition agent to promote a uniform adherent deposit of tin The bath is run at a moderate temperature and high current density The anodes are high-silicon iron except for one or two tin anodes used to maintain the tin content of the bath The operation frees the work from scale or oxide and covers it with a thin film of tin without effecting any dimensional change No etching of the tin occurs and the racks are also protected by the tin film If desired, the tin coating can be stripped in a bath operated as in the degreasing process

Nicotine Extraction

A LIQUID-LIQUID PROCESS FOR extracting nicotine from water by kerosene is under investigation at the *Eastern Regional Research Laboratory*, U S A Distribution coefficients at various temperatures and concentrations and the data on continuous kerosene water extractions have been worked out and a pilot plant based on these results is under construction (*Ind & Engng Chem* , 1950, **42**, 166)

The equipment consists of an overhead reservoir containing a solution of nicotine in tap water, ranging in concentration from 0 10 to 0 15 per cent by weight The nicotine solution from the reservoir flows through a rotameter via a heating coil into the top of a packed column Kerosene oil of sp gr 0 82 and flash point 70°C from another overhead reservoir flows through a rotameter via a heating coil and a distributor up through the packed column The tubing employed is made of polyvinylidene chloride plastic and the heating coils are of copper The packed column is made of 1 875" inside dia glass tubing 48" long The upper 6" and lower 3" of the column has no packing The packed section is 39" long with 0·0624 cu ft of free space The kerosene distributor is made from a 0 25" I P S cap with 7 holes of 0·0625" dia

In most of the runs water was the continuous phase and kerosene the dispersed phase, the interface was held in the upper 6" of the column (above the packing) The column packings investigated were (a) 0 25" ceramic Berl saddles, (b) 0 375" ceramic Raschig rings (0 375" outside dia × 0·25" inside dia × 0 375" long), (c) 0 5" Berl saddles, and (d) 0 5" Raschig rings (0 5" outside dia × 0 3125" inside dia × 0·5" long)

Nicotine solutions ranging from 1 01 to 793 9 gm of nicotine per litre were investigated at temperature ranges 5° to 98°C 10 to 50 c c of the solution measured out in an Erlenmeyer flask and an equal volume of Deobase (a commercial, refined and deodorized kerosene, d o 7797 and a boiling range of 160° to 250°C) added and the flask maintained at the desired temperature for 24 hr A sample of the water layer was then analysed and nicotine determined by precipitation with silicotungstic acid The solubility of Deobase in the water phase is negligible

At 0 5 to 0 6 per cent nicotine in water which is the usual concentration in industry, and with equal volumes of solvent and solution, approximately 48 per cent of the nicotine was removed in one extraction stage at 25°C, whereas at 85°C about 83 per cent was removed In the solvent extraction of nicotine with kerosene it is obviously advantageous to operate at high temperature

Maximum density of water-nicotine solution occurred at 65 per cent nicotine whereas the density of kerosene nicotine solutions increased linearly with concentration The distribution coefficient was constant at any one temperature up to a concentration of 1 per cent nicotine in the original solution The coefficient decreased with increasing temperature at all concentrations In concentrations below 1 per cent it decreased from 3 4 at 5°C to 0 2 at 85°C At constant temperatures the coefficient increased with concentration, reached a maximum between 50 and 70 per cent nicotine, and decreased again at higher concentrations By increasing the temperature from 21° to 84°C, extraction of nicotine from water in a packed column increased from 28 to 92 per cent Extraction increased by about 8 per cent by packing the saddles loosely instead of tightly The saddle type of packing gave about 5 per cent higher nicotine extraction than the same size of ring packing

Cyclone Dust Collectors

CYCLONE SEPARATORS FIND APPLICation in many industries for the separation and collection of finely ground particles of matter Professor A J ter Linden, in a recent publication, has dealt with the various factors relating to the design of cyclone dust collectors (*Proc Inst of Mech Engrs* , 1949 **160**, 233) The shape of the cyclone is determined by the following principal dimensions (1) inlet angle of gases, (2) diameter of cyclone (D), (3) gas exhaust diameter (d), (4) length of exhaust pipe inside cyclone (S), (5) height of cyclone (H), (6) height of cylindrical part of cyclone (h), (7) width of gas inlet (A), (8) height of gas inlet (B) From experimental work it appears that a gradual entry of the gases into the cylindrical part of the cyclone is essential and the best efficiency is obtained when the inlet angle is 180° For high efficiency, the following dimensions are recommended $S \simeq d$ or $S \simeq B$ when $B > d$, $H \geq 3D$, $D = 2\ 5\ d$, $H = 6d$ to $7d$ and $A = B$ and the cross-sectional area of the inlet duct ($A \times B$) not much smaller than that of the exhaust

The influence of gravity on the dust separation in a cyclone is slight and a good cyclone effects a satisfactory separation in any position

A new type of cyclone with curved axis, horizontal gas exhaust, and vertical downward dust outlet is described From a consideration of the vertical, radial and tangential components of the velocity and the static pressure inside a cyclone, a simple theory is developed enabling the approximate calculation of the size of the largest particles that may escape a cyclone The efficiency of a cyclone increases and the particles that escape it become gradually smaller as the diameter of the exhaust becomes smaller In view of the pressure drop the velocity of the gas in the exhaust may not be raised too high, it is essential to replace a large cyclone by a number of small ones connected in parallel (multi cyclone construction) The dust concentration has little influence on the efficiency With an increasing dust concentration, the efficiency will also increase slightly, provided no obstruction occurs in the dust outlet Efficiencies are given for different sizes of similar shaped cyclones and for various sizes of dust particles This data enables the selection of a cyclone collector suitable for a particular kind of dust and the choice of cyclone dimensions for a given efficiency If a high efficiency for fine dust is required, it is necessary to use very small cyclones The efficiency of a small cyclone is very high, and it has been shown how this property of a small cyclone may be used to measure easily and accurately the dust content of a flow of gas

Fusible Alloys

THE COMPOSITION, PROPERTIES and applications of some of the tin-containing fusible alloys are discussed in a 24-page booklet recently published by the *Tin Research Institute*, England.

The alloys are based on the eutectics occurring in the alloy systems formed by metals of intrinsically low melting point, e.g. tin, bismuth, lead and cadmium. Alloys of very low melting points formed by the addition of gallium or indium are described. Some of the fusible alloys owe much of their industrial importance to the volume changes during and after solidification of the alloy, on which depends the production of castings having dimensions equal to, or greater than, those of the mould in which the metal is cast. The factors influencing such dimensional changes are discussed in detail.

The low melting temperatures of fusible alloys enable them to be cast in wooden or paper moulds and poured around hardened steel dies without danger of affecting the hardness of the tools. Their use in aircraft factories, foundries and engineering workshops has simplified many assembling operations and production processes and resulted in considerable saving in time, labour and materials. Thin-walled tubes and open sections containing these alloys as filling material can be bent without risk of buckling or cross-sectional distortion and the manufacture of intricate holloware, such as ornamental handles for cutlery, is facilitated. Metal to metal joints can be made by conventional soldering techniques at temperatures as low as 100°C and vacuum-tight seals can be made between glass and glass or glass and metals.

Some of the novel uses to which the fusible alloys have been put to, include determination of the maximum temperature attained by the valves of internal combustion engines and bearings of motors which are not easily accessible with the usual thermostatic measuring devices, making casts of features and finger print impressions using the quinary eutectic containing indium which melts at 47°C and can come, in molten state, into direct contact with the human body without discomfort. Other important applications where fusible alloys find use are in safety devices, foundry patterns, moulds for thermo plastics, magnetic assemblies, electro-forming processes, dentistry and metallized wood.

The booklet has an adequate bibliography and is illustrated by photographs showing the use of fusible alloys in aircraft assembly jigs and in press tools. It is obtainable free on application to Tin Research Institute, Fraser Road, Greenford, Middlesex.

A New Oscilloscope

DEVELOPMENT OF A DEVICE BASED on the Graphecon and the use of a television screen (instead of the conventional oscilloscope) which permits the study of instantaneous phenomena is reported at the *R C A Laboratories*.

The main feature of the device is the Graphecon memory tube which consists of a target on which an electrical charge, such as an oscilloscope or radar trace can be "written" at any speed desired by an electron gun. The charge, or signal, is scanned or "read" off the reverse side of the target by an iconoscope type electron beam such as is used in television. The beam may take as long as 60 sec. to completely remove the charge — thus providing the storage period. The signal is then amplified and applied to a kinescope or television viewing screen for inspection or photographing.

Reed Vibrometers

THERE ARE MANY PROBLEMS associated with the elimination of vibration encountered in engineering practice. The harmful effects of vibrations on machine parts and structures are well known. *Messrs G E C (India) Ltd* have put on market a simple reed vibrometer, useful in on-site analysis of vibrating structures.

This instrument has a reed in the form of a steel strip whose effective length can be varied by means of a knob on the side of the vibrometer. This is done until the natural frequency of the disturbance, when the reed will vibrate most vigorously, be easily observed. A scale on the vibrometer indicates the fundamental frequency of vibration. This instrument, designed essentially for use on linear systems of vibrations contains an electromagnetic pick-up in close proximity to the reed which permits a display of the results on a cathode-ray tube.

Absorption Bands of Uranyl Salts

THE ABSORPTION SPECTRA OF several uranyl salts at liquid air temperature have been analysed in a manner similar to that adopted for the fluorescence spectra (*Proc Indian Acad Sci*, 1950, **31**, 35).

The relationship between the two spectra is shown by two closely-lying common bands (a_0 and b_0 in absorption) at low temperatures. In fluorescence, the lower frequency band b_0 is always more intense than the a_0 band while in absorption the reverse is usually the case suggesting thereby that transition to the ground levels in the uranyl ion is from a single upper state and that the origin of the b_0 and a_0 bands is due to transitions to this state from the two low-lying electronic states (named X and Σ), the latter of these being the ground state. Analysis of the spectra of 6 uranyl salts shows that the two levels (A-B interval) in the ground state, which are separated by a small frequency interval of nearly 150, take part in absorption. The appearance of c however, involves a level nearly 220 above the lowest state. In view of the high transition probability for this series, its existence for this series is proved to be justified. The necessity of using much higher levels (as high as 2 000 as done by earlier workers) does not arise.

Polarographic Determination of Digitoxin

POLAROGRAPHIC METHOD FOR THE estimation of digitoxin in concentrations as low as 0.1 μ gm in alcoholic solutions and in blood is described (*Science* 1949 **110**, 526).

Varying amounts of a stock solution of the pure drug prepared in absolute alcohol and then diluted with distilled water were added to 0.5 c.c. of 0.2 N tetraethyl ammonium hydroxide in a Heyrovsky reaction vessel and diluted to 5 c.c. total volume with 50 per cent alcohol solution in order to study the half-wave potential and height of break at different concentrations. Nitrogen was bubbled through the solution for 15 to 20 min. and the polarogram recorded. The process was repeated until a satisfactory curve of height versus concentration had been determined and the average half-wave potential was calculated. The determination in blood was carried out by extraction of digitoxin with petroleum ether, followed by polarographic estimation as above.

In concentrations down to approximately 0·6 μ gm , the alcoholic solution and the blood extraction curves coincided reasonably well Below this concentration, the curve of digitoxin extracted from blood drops sharply and approaches zero This drop may be due to the distribution of digitoxin between the extraction solvent and blood at these low concentrations The average half-wave potentials were found to be −1 965 in alcoholic solutions and −1 958 when extracted from blood

Determination of Magnetic Field Intensities

A NEW TECHNIQUE FOR THE quantitative study of electrostatic and magnetic fields of extremely small dimensions developed at the *National Bureau of Standards* is described (*J Franklin Inst* , 1949, **248**, 540) The new method is better adapted to precise determination of field intensity

The object to be studied is placed between an electron source and a system of electron lenses The lens system focuses the electron beam to form an image of the object on a fluorescent screen By placing a wire mesh of known gauge just beyond the back focus of the lens system, a shadow image of the mesh is superimposed on the image of the wire The portion of the shadow network adjacent to magnetized regions of the recording wire show considerable distortion which has been found to be due to the deflection of the electron beam by the field of the recording wire at each magnetized region The displacement and change in size of the shadow image, which depend on the strength of the field of the magnetized wire give an accurate measure of the field intensity

The technique is well adapted to investigation of the fundamental nature of ferromagnetism and is being applied to the study of spherical aberration in electron lenses

New Microsectioning Technique

EXTREMELY THIN SECTIONS OF uniform thickness (fractions of a micron) for study with either the light or electron microscope can be obtained by a simple device developed at the *National Bureau of Standards* (*J Franklin Inst* , 1949, **248**, 541)

The specimen embedded in polybutyl methacrylate is fed to the microtome in extremely small increments by means of the thermal expansion of a metal specimen holder cooled by CO_2 As the holder begins to warm and expand it moves towards the cutting edge of the microtome The length of time between cuts and the control of carbon dioxide determine the thickness of the section

Plasma Substitute

INVESTIGATIONS LEADING TO THE development of a satisfactory non-antigenic and inexpensive plasma substitute from sugar beet juices are described (*Uppsala Lakareforenings forhandlingar*, 1949 **54**, 107) The product has found extensive use in the treatment of shock prophylaxis

High molecular dextran when partially hydrolysed with the aid of acids yield products with molecular weights of the order of magnitude of 1,00 000 By varying the conditions of hydrolysis products with molecular weights in a range of 20,000 to 2 00,000, suitable as a plasma substitute can be obtained This treatment was carried out on a 8 per cent solution of a high molecular dextran at 90°C Hydrochloric acid was added until the solution became 0 12 *N* After 20 min the hydrolysis was interrupted by neutralization with NaOH and dextran precipitated with alcohol and dried At this stage a major portion of dextran molecules have a large molecular size A more homogeneous preparation was obtained by performing a fractionation procedure which eliminated the largest and the smallest molecules

Fractionation of dextran isolated from the urine of patients given intravenous infusions of partially hydrolysed dextran revealed that molecules slightly larger than the magnitude of molecular weight 36,000 were excreted Adsorption experiments with active carbon on some of the fractions indicated that the adsorption increases with decrease in molecular weight except in the series glucose, disaccharide, trisaccharide, etc , where adsorption increases with increasing molecular weight

The clinical tests have shown that the result of shock treatment with dextran is good and that when required several litres of dextran solution can be injected without the occurrence of injurious secondary reactions The dextran concentration in plasma can rise to several per cent, in which case the concentration of protein can be appreciably lower than normal The concentration of the colloids seems to adjust itself so that the colloidal-osmotic pressure of the blood becomes normal A part of the blood-protein can consequently be temporarily replaced by dextran without inconvenience Afterwards new plasma protein is formed at the same time that dextran disappears from the blood

Raw dextran is produced by *Swedish Sugar Corp* by cultivating *Leuconostoc mesenteroides* in sterile sugar solutions The very high molecular dextran formed in the sugar solution is precipitated with alcohol It is partially hydrolysed with HCl and purified by several reprecipitations and filtrations through adsorbents after which the material in dried *in vacuo* Solutions containing 6 per cent partially hydrolysed dextran and 0·9 per cent NaCl are prepared and sterilized at 100°C Each batch of the product is so controlled as not to contain fractions of dextran with too high a molecular weight Methods have been worked out for fractionation of the polymolecular dextran into products more homogeneous with respect to molecular weight

Jute Substitutes

WITH A VIEW TO FIND SUITABLE jute substitutes, an intensive study of various indigenous fibre plants is being conducted under an elaborate programme of research planned by the Indian Central Jute Committee Extensive surveys of fibre plants from different parts of the country and abroad are in progress and the following plants so far collected are being studied for isolation and breeding of improved strains, varietal trials, inheritance characteristics, cultural methods and economics of growing the various crops, anatomical and cytological investigations, the incidence of pests and diseases, and technological examination of fibres *Hibiscus cannabinus* (Mesta), *Boehmeria nivea* Ramie, Agave spp (sisal)

Varietal trials on 5 improved sunn-hemp varieties and inheritance studies on pigmentation, hairiness and leaf characters of *Hibiscus sabdariffa* (Rosella) are in progress in different parts of the country A plantation of *Boehmeria nivea* (Ramie) has been set up at Chinsurah farm Work on this is in progress along the following lines isolation, selection and multiplication of desirable types, study of degumming and extraction process of the fibre by biological and mechanical means, economics of cultivation and evaluation of technological possibilities A plantation of *Agave sisalana* is being set up and bulbils are being reared in the nursery for the purpose Induction of polyploidy in *Sida, Urena, Hibiscus cannabinus* and *Hibiscus sabdariffa* are being carried out Trials are in progress with different chemicals for hastening germination in slow germinating seeds Incidence of a number of fungal and bacterial diseases on different fibre crops are being studied *P sabdariffa* and *Ceroospera hibisci* on *H sabdariffa var altissima, Uromyces spp* on *Crotalaria juncea*, fusarium on *Urea lobara* and *Crotalaria juncea* Detailed studies on the biology of *Phenacoccus hirsutus* and *Spermophagus tessellatus*, the former a pest of *H sabdariffa var altissima* and the latter a pest of mesta seeds, are also being conducted An indigenous predator on *Phemacoccus hirsutus* has been located for biological control of the pest.

Control of Tomato Hornworm

THE CONTROL OF TOMATO HORNWORM on tobacco is described (*Sci Agric*, 1949, **29**, 553) Flue-cured tobacco was used in all the experiments Nicotine bentonite, synthetic cryolite, barium fluosilicate, calcium arsenate, lead arsenate, chlordane, benzene hexachloride and DDT were employed The effects of varying strengths of the insecticides indicate that in the case of arsenate of lead, a thoroughly applied early spray was effective Synthetic cryolite proved effective at a rate of 18 to 20 lb per acre, because of its higher cost it cannot be widely used DDT was by far the most effective, even at comparatively low concentrations (0 72 lb per acre) Moreover, it did not leave much undesirable residue on the foliage as lead arsenate or cryolite.

Central Pepper Research Station, Madras

RESEARCH ON VARIOUS ASPECTS of pepper cultivation is to be undertaken in a Central Pepper Research Station to be established in Payannoor in North Malabar, Madras, with a view to rehabilitate the pepper industry in South India The programme of work includes collection of all existing varieties of pepper and the study of their agronomic and genetic characters hybridization of promising varieties with the wild and cultivated types to evolve better types, comparative trials of varieties for vigour, yield, resistance to pests and diseases, etc , study of relative merits of different cultural practices, study of manurial requirements, study of root system of the pepper plant in relation to soils and the effect of hydrogen ion concentration on the development of the system, study of the relative merits of different varieties shade regulation in respect of yield, diseases of pepper, insect fauna that attack the root stem, leaves, flowers and methods for their control, and study of the physiology of spike shedding

Disease-resistant Tobacco Hybrid

NEW HYBRID TOBACCO PLANTS that are resistant to major tobacco plant diseases have been obtained in the United States by cross-breeding wild tobacco plants with domesticated species, the former being used as the pollen source and the latter as the female parent The progeny has proved to be both stable and fertile (*USIS*)

Announcements

Prof M S Thacker, Head of the Power Engineering Laboratory, Indian Institute of Science, has been appointed Director, Indian Institute of Science, Bangalore

Dr H S Pruthi and *Dr S Pradhan* were elected President and General Secretary respectively of the Entomological Society of India for the year 1950 at the Annual General Meeting of the Society held at Poona

The following were elected office bearers of the Indian Ecological Society for the year 1950 at the Annual General Meeting of the Society held in Poona President Dr F R Bharucha, Hony General Secretary and Hony Treasurer Dr B S Navalkar; Hony Jt Secretary Dr T J Job

Dr B P Pal and *Dr R Misra* have been elected as President and Hony Secretary respectively of the Indian Botanical Society for the year 1950 at the Annual General Meeting of the Society held during January 1950

Dr B B Mundkur and *Dr R Prasada* have been elected President (for 1950) and Secretary-Treasurer (for 1950-52) respectively of the Indian Phytopathological Society

Dr Walter Baukloh, formerly Professor of Metallurgy and Director of the Institute of Iron-metallurgy, Technical University of Berlin, has joined the Bengal Engineering College, Sibpur, as Professor of Metallurgy

Publications Received

Industrial Microbiology by S C PRESCOTT & C G DUNN, McGraw-Hill Book Co Inc 1949 pp x + 386, price $ 8 50

Organic Chemistry, by G B BACHMAN, McGraw-Hill Book Co Inc, 1949, pp x + 432, price $ 4 25

Elements of Thermodynamics & Heat Transfer, by EDWARD F OBERT, McGraw-Hill Book Co Inc, 1949, pp xiv + 372, price $ 4 50

Frequency Modulated Radar by DAVID G C LUCK, McGraw-Hill Book Co Inc, 1949, pp xviii + 466, price $ 4 00

Theory of Wing Sections, by IRA H ABBOTT & ALBERT E VON DOENHOFF, McGraw-Hill Book Co Inc, 1949, pp viii + 693, price $ 15 00

Bengal in Maps by S P CHATTERJEE, Orient Longmans Ltd, 1949, pp 105 + 1 flow sheet map, price Rs 1/8

The Indian Handloom Weaving — Industry Annual, 1949, by M P GANDHI, Gandhi & Co, 1949, pp 67, price Rs 1/8

Metal Market Review — 1949 Annual, Calcutta, pp xxxviii + 202, price Rs 5

The Non-parasitic Disorders of Apple Fruit in Australia (Bulletin No 238, C S I R, Australia), Council for Sci & Ind Research, Australia, 1948 pp 83 + 24 plates

Synthetic Petrol by S L BHATIA, Indian Science News Series, Govt College, Ludhiana (Punjab), 1949, pp 92, price Rs 2

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for February 1950

Organic Chemicals

41785 New naphthylpropionic acids and derivatives *Reacting naphthyl-(2)-alkyl ketone with a halogen acetic acid ester in the presence of a metal and exchanging the hydroxyl group for hydrogen* — Ciba Ltd

42101 Recovery of organic liquids or solvents *Mixing steam to the mixture of gases and solvent vapour and fractionating* — A P V Co Ltd

41511 Vat dyestuffs *Dyeing with cobalt phthalocyanine or its substitution product as vat dyes* — Bayer & Cauer

40344 New dyestuffs for wool *Sulphonating 2 = aryl = 1′ 9′ = anthrapyrimidines which contain as substituent in the 6 position* — I C I Ltd

42182 New cinnoline derivatives *Reacting a pyrimidoaminocinnoline with a quaternating agent* — I C I Ltd

Food & Kindred Products

40058 Extractor for vegetable oils and process of extraction *An extracting chamber and a collecting chamber and a filler between said chambers wherein the extracting chamber constitutes a space between said filler and a foraminated wall disposed concentrically to two chambers* — Beuttenmuller

Fuels & Lubricants

41106 Low temperature carbonization *Maintaining the temperature of the gases and vapours in the off-tape above the condensation point of the components of the mixture* — Steinschlaeger

41001 Process and installation for the manufacture of gas mixtures by gasifying fine-grained carbonaceous material *Gasifying carbonaceous material in two reactors, the volume of one is much larger than the other and the principle applied is "cross-flow"* — De Directie Van De Staatsmijnen in Limburg

40375 Carbonization process *Injecting a gas-borne stream of coal particles into a fluid carbonization bed* — I C I Ltd

Leather & Leather Products

40609 Imitation leather *Mixing aqueous disintegrated fibrous material with finely divided rubber particles and finally fabricating the mixture* — Kemp & Underfelts, Ltd

Drugs & Pharmaceuticals

40789 Manufacture of oestrone and intermediate products *1-oxo-2-methyl-*1 2 3 4 9 10 11 12*-octahydro-phenanthrene-*2*-carboxylic acid ester is reacted with halogen acetic ester, water is split off, the resulting compound is hydrogenated and hydrolysed and finally treated with a cyclising agent* — Ciba Ltd

41146 Insecticidal compositions *Containing a carrier and a dithiophosphate ester* — American Cyanamid Co

Metal & Metal Products

41686 Method of welding aluminium *Comprising continuously feeding aluminium wire to a point adjacent and spaced from a work piece, maintaining electric arc between wire and work piece, and delivering an inert gas to form an arc atmosphere* — Air Reduction Co Inc

41798 Fluxes for use in the treatment of light metals *Comprising at least two chlorides of the group consisting of chlorides of the alkaline earth metals including magnesium, more than 20 per cent of the flux being barium chloride* — Magnesium Elektron Ltd

41811, 41824 Condensation of zinc from its vapour in gaseous mixtures *Carrying out the condensation in two stages viz a first stage of surface condensation and a second stage of condensation in a mechanically produced shower of molten zinc The gases from furnace brought into intimate contact with a spray of molten zinc below the dew-point for zinc, and gases thereafter passed through a vertical stack above the spray* — The National Smelting Co Ltd

Paper & Allied Products

42093 Machine for the intensive opening of fibrous materials *A striffing beater having on its periphery a series of flexible flaps extending radially therefrom, the beater moving at a higher peripheral speed than the taker-in* — T M M (Research) Ltd & Hunter

Rubber & Rubber Products

42046 Vulcanizing rubber sheet *Passing the sheet of rubber within a popularity of rollers whose axis lie along the edges of a prism and then vulcanizing the sheet while moving* — Dunlop Rubber Co Ltd

42127 Apparatus for automatically cutting predetermined lengths of tubular or rod-like material *Having a guide member having a plurality of holes for guiding the material, a cutting member adapted to traverse each of the said guide holes in turn* — Dunlop Rubber Co Ltd

Stone, Clay & Glass Products

42196 Manufacture of fibres of glass, slag, etc *Projecting molten material on a rotating disc and fibres projecting downwards are cut into determined lengths* — Algemeene Kunstvezel Maatschappij, Naamlooze Vennootschap

Textile & Textile Products

42263 Double twist spindles *A rotatable vertical spindle having an axial passage, a yarn guide*

(*Continued on page* 142)

Patented Inventions of the Council of Scientific & Industrial Research

PRODUCTION OF NITROPHENETOLES & NITROANISOLES

B B Dey, T R Govindachari & H V Udupa

NITROPHENETOLES AND NITROANISOLES ARE INTERmediates for dyestuffs *para*-nitrophenetole is also used in the production of phenacetin and other drugs

Patent No 33473

The conversion of nitrochlorobenzenes to nitrophenetoles or to nitroanisoles is effected by heating with ethyl or methyl alcohol respectively in presence of alkali metal hydroxide and is characterized by the use of lead peroxide as a catalyst in the conversion A minimum of one part by weight of lead peroxide for every four parts of nitrochlorobenzene is used The proportions of the other ingredients are as follows

(i) for the preparation of nitrophenetoles 300 c c of 95 per cent ethyl alcohol for every 20 gm of nitrochlorobenzene ,

(ii) for the preparation of nitroanisoles, 200 c c of 95 per cent methanol for every 20 gm of nitrochlorobenzene , and

(iii) 2 15 moles of sodium hydroxide for every mole of nitrochlorobenzene In the case of nitrophenetoles, the heating is conducted for 15 hr with gentle reflux using 0 67 N alkali For nitroanisoles, the heating is for 20 hr with gentle reflux using 0 67 N alkali or for 15 hr using 0 89 N alkali

Patent No. 34411

Cuprous oxide is used as a catalyst in the process of conversion of nitrochlorobenzenes to the corresponding nitroanisoles or nitrophenetoles High yields of the pure products have been obtained even when the amount of catalyst added is only 5 per cent by weight of the nitrochlorobenzene used Thus, when 5 per cent of the catalyst is used, the yield of *para*-nitrophenetole is 90 1 per cent, of *para*-nitroanisole 96 8 per cent and of ortho nitroanisole 92 6 per cent For the production of ortho nitrophenetole a larger proportion of the catalyst, 20 per cent and above, is necessary to secure good yields

Nitrochlorobenzene (20 gm) is catalytically reacted with ethyl or methyl alcohol in presence of sodium hydroxide (11 gm) at boiling temperature with stirring for 15-20 hr

Patent No 34754

Manganese dioxide is employed as a catalyst in the preparation of nitroanisoles and nitrophenetoles from nitrochlorobenzene The method is effective in suppressing by-products and gives high yields The manganese dioxide may be recovered completely and used over and over again

20 gm *para* nitrochlorobenzene, 300 c c of 95 per cent ethyl alcohol , 11 gm sodium hydroxide , 20 gm manganese dioxide stirring for 15 hr at boiling temperature yields 19 5 gm of *para*-nitrophenetole, m p , 58°C

INDIAN PATENTS — *Continued from page 141*

fast on the spindle a yarn package carrier, a yarn guide on the carrier and vanes on the carrier — REGINA

41387 Process and apparatus for printing textile fabrics *Applying a film of insoluble glue to one side of a paper sheet, coating said glue film with a layer of fatty substance, colour printing the design on the treated side* — COLOMBO

Miscellaneous

42120 Electrodes and processes for their manufacture *Dry substance before addition of the binder is calcined to such an extent that in the baked electrode the dry substance and coke formed by the binder will have approximately same reactivity and electrochemical super-tension and will be moistened approximately to the same extent by the electrolytic bath* — ELEKTROKEMISK

41752 A tube-well boring machine *Comprising a clamp to support the casing to be rotated and lowered a rotatable body having vertical guides to engage the clamps and means for rotating the rotatable body* — CHAKRAVARTY

41025 Method of, and apparatus for, continuously digging coal *Comprising simultaneous chipping and removing coal from region of the chipping operation* — SUNNYHILL COAL CO

41212 Process and apparatus for carrying out reactions of gases with fine-grained substances *Particles of fine-grained substance are carried out by gas in upward direction through a vertical column consisting of reaction spaces superimposed upon each other in such a manner that gas current carrying the particles enters each of these reaction spaces in a direction inclined to vertical* — DE DIRECTIE VAN DE STAATSMIJNEN IN LIMBURG

41947 An improved chemical closet *A set of pressure levers below closet seats operates means to ratate a rotor in the chamber containing chemical solution, when a person vacates the seats* — CHHAGAN ISHWARLAL & VASAVADA

42425 Apparatus for treating gases with liquids *The girds are spaced a short distance apart and the dripping liquid falling from upper grid on the lower grid produces ripple in it* — C D PATENTS LTD

Food & People — Development of Fisheries*

A LASTING and nationwide development of fisheries must be a slow and gradual process of the evolutionary type, and any hurried spectacular measures are bound to fail The pace of development will largely depend on the training and experience of the personnel actually engaged in the fishing industry or its betterment from a purely administrative point of view This naturally would lead to a consideration of the interrelationship between the quantity of variety of food to be produced, the producers' socio-economic conditions and the tastes and likings of the consumers We have hitherto ignored these fundamental considerations and have worked our programmes according to western ideas and to our own likes and dislikes without regard to the peasant economy in India and the ancient genius of our people The problems of food production are peoples' problems, and can, therefore, be best tackled among the people in the field

It was a great surprise for me to learn that not very long ago, about 30 to 40 years, the agriculturists in the U S A were contemptuously called "Hay-seeds" and the fishermen by a still worse name The present position is that an agriculturist is envied by every one and the income and standard of living of an average Pacific fisherman is superior to the university teacher's The fisherman calls for research himself and is prepared to pay for it, for he knows that increased food production is not only good for the people but it brings him more money for a still better standard of living It is my considered opinion, based on discussions with eminent fisheries authorities in the U S A, that the first and foremost requisite for increased fish supplies in India is to deal with the backward fishing community most sympathetically and raise its socio-economic standard If we had paid attention to this aspect right from 1942, when the Fisheries Directorate was re-established in Bengal, we would not have complained of shortage of fish supplies but today may have been thinking of export markets

There is a Punjabi saying which when freely translated would read as Listen my friends, among the occupations most suitable for man, agriculture is the most superior, next comes trade and commerce (business) and the worst of all is service of any kind This shows the great value that was attached to the agricultural labour in the past In the present circumstances, it seems to me most appropriate that the nation should assign a very high social status to the producers of food This will check the exodus from the land to urban areas and may even lead the educated people to go back to their lands Some socio-economic research is called for to achieve these results but once the dignity of labour is recognized the battle for food will be won in no time

Consumer Research Essential

In discussing measures for fishery development in an informal meeting, the representatives of the Fisheries Section of the United Nations Scientific Conference realized that the foremost need in any programme of increased production was consumer research How true this is will be clear from the Report of the Herring Meeting held in the Hague (Netherlands), from 29th August to 2nd September 1949, under the auspices of the F A O It was felt at this meeting that with the application of recently discovered innovations such as the echo-sounder, midwater trawl, radio-telephone, aeroplane tracing of herring, pumps for discharging fish from gear and from vessels, the production was bound to increase, but the marketing of increased production was the greatest obstacle at present. It was suggested in this connection that "the hitherto unexplored possibilities of opening up new markets in Asia and Africa, by the processing of herring in a form acceptable to the people of these continents, is a challenge to the industry. Attempts to introduce traditional European herring cures into Asia and Africa are not likely to have much success, but a study of the tastes and processing methods for fish in Asian and African countries may provide a clue for a process that could be applied to herring and make it salable in those countries."

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* From a contribution by Dr Sunder Lal Hora to the symposium on "Food & People" organized by the Botanical Society of India The paper in its original form will be published in the *Journal of the Botanical Society*

Consumer research in food industries is very important, for sometimes consumer tastes change irrespective of price. This imposes on the industry the need to study the reasons for these changes in consumer habits, and the need to devise new and more acceptable forms in which to market their products. I am aware of at least one small catfish of Bengal, *Nuna tengra* (*Aoria gulio*), in which case the consumer habits changed during the last war. This fish was considered inferior in the Calcutta markets by the middle-class people but during the war, when carp and other larger varieties became expensive owing to military requirements, the people took to eating this fish and found that it made excellent curry on account of the abundant oil in its body tissues. Now this species fetches almost the same price as the larger varieties of carps and catfishes and a big market for this species has developed. If consumer tastes could be developed for other smaller varieties of fish which are at present uneconomical to catch and market, supplies will be abundant and prices will fall appreciably. I have seen in the Sundarbans fishermen throwing away large quantities of smaller fishes for lack of any market for them. It seems necessary, therefore, that for the increased marketable production of fish, consumer research is of paramount importance but, unfortunately, this has not as yet been attempted in India.

Build on Ancient Skill

Another reason why food production is not making headway in India became clear to me when I was attending the Pacific Tuna Fisheries Conference at San Pedro on 10th October 1949. It was freely mentioned that any improvement in catching methods should be economical as compared with the existing practices, and for this reason present-day catches and their costs should be borne in mind constantly. This is a very healthy outlook and should be borne in all development plans in India. Having paid considerable attention to the measures adopted in the west for food production, I feel that it will be ruinous for us to imitate those practices because they are not applicable to the peasant economy in India, to the social structure of the society, and to the traditional knowledge we have acquired through centuries of experience. Has any one investigated against the socio-economic background of the peasantry in India whether the method and technology perfected in advanced countries are applicable to the so-called under-developed countries? I am afraid, not. Our peasants may be illiterate but are by no means ignorant, they may be conservative but not without reason, they may be superstitious but not without experience of natural phenomena. I have personally found the fishermen full of knowledge but unfortunately the society gives them no chance. We do not blame any individuals, the whole structure of the society requires reconstruction. Here again is a challenge to the men of social sciences. Summarizing the views of the Fish Section of the U N Scientific Conference on the cultivation of fresh and brackish water fish in warm climates, Mr Michael Graham of the U K stated:

"Here there is room for very great expansion. And what is more, it is almost on the door-step of many millions of people in tropical countries who are at present protein-starved. In some areas, such as the rice country, they can hardly hope ever to obtain flesh because the land is all taken up for rice. The greatest skill in this art of pond-culture lies traditionally in China, secondly in the continent of India, and the first aim is to spread their methods round the world, with suitable local modifications. We should build on what we have. But new possibilities, such as the greater use of the various species of the fish called *Tilapia*, were also mentioned. It was the manifest opinion of the meeting on August 24 that the possibilities for human betterment, by the increase of tropical pond-culture, could hardly be exaggerated. At the same time we realized that success would depend on human cunning and tact in dealing with all the varieties of ponds and lakes and lagoons and water courses Our skill must be no less subtle, though more scientific, than the traditional fine discrimination of the Chinese masters of the art We should build on ancient skill but spread by scientific understanding " No other method of approach in the under-developed countries can be effective or everlasting

Man, the Greatest National Resource

The United Nations Scientific Conference was debarred by the terms of its reference to pass any resolutions, and its main objective was to facilitate the exchange of views among scientists of various countries In the concluding phases of the Conference, it was more and more realized that in the development of natural resources it was necessary to pay more attention to màn, for he was the greatest natural resource This view found expression in Resolution No 1 of the International Technical Conference on the Protection of Nature which was held from the 22nd to the 29th August at Lake Success under the auspices of UNESCO The resolution is worth quoting in its entirety

" *Whereas* the United Nations and its Specialized Agencies are studying programmes of technical assistance for under-developed countries, which programmes, to be effective, require the application of human ecological principles, ecology being understood in its widest sense to include all human relationships — individuals and groups — with the problems discussed, it is essential that existing information should be collected and new studies that are urgently needed should be initiated and

" *Whereas* it is recognized that one of the first and greatest responsibilities of the United Nations and its Specialized Agencies concerned with the use of resources and of the International Union for the Protection of Nature, is to increase knowledge of human ecology, and to assure its application on a scientific basis, and

" *Whereas* this Conference recognizes the necessity of close and continuous integration of all programme and methods for the study of human ecology,

" *Therefore this Conference resolves* that the International Union for the Protection of Nature recommend to the above-mentioned bodies the promotion of studies of suitable areas as a step towards the development of an adequate methodology for investigation of human ecology, and

"*Further resolves* that such studies be conducted along the following lines (1) One or more ecological areas shall be selected for thorough-going study, including the human factors in the situation , (2) these ecological areas should be selected so that they shall be (a) practicable units for a simple, integrated programme, small enough to permit complete studies, and large enough to provide significant results, and (b) distributed through representative bio-geographic areas , (3) each area shall be treated as a total dynamic ecological situation, including all possible factors such as soil, water, food, climate, plants, animals, and the people concerned, with special emphasis on their interrelationships , (4) these studies shall be made by teams of scientists trained in ecological methods This multi-discipline and inter-discipline approach is to include the methods of the physical and biological sciences together with those of human ecology, medicine, sociology, anthropology, genetics, economics and psychology , (5) these studies should be concerned not only with the amassing of data and the interpretation of the ecological situations under study, but also with the development and recording of the methodology used, including the logic, concepts, methods, procedures, techniques and " inventions " — physical, biological, and social , (6) the findings of these studies, both in fact and in method, will assist in the orientation and integration of all the different disciplines applied in the studies , (7) the results of these studies should be published and made available to specialists Also, popular versions of the significant results should be made available in several languages to the general public "

Those of us who have worked in the field and among the people have realized that for any programme of food production a thoroughly reliable and efficient extention service is far more important than multitudes of research stations and organizations It is not only that food is essential for people but properly informed people are also equally essential for food production Let us, therefore, bring the problems of food and people together and consider them simultaneously

SUNDER LAL HORA

Board of Scientific & Industrial Research
Twenty-fourth Meeting, New Delhi

THE twenty-fourth meeting of the Board of Scientific & Industrial Research was held in New Delhi on March 18, 1950

On the recommendation of the Board, the Governing Body of the Council of Scientific & Industrial Research sanctioned the following 20 new research schemes

1 Manufacture of vanillin on a pilot-plant scale from cinnamon leaf oil and clove oil *Hindustan Fine Chemicals Co, Bangalore*

2 Manufacture of α- and β-ionone on a pilot-plant scale *Hindustan Fine Chemicals Co, Bangalore*

3 Studies in the copper-rich portion of the copper-titanium system and preparation of copper-titanium alloys PROF G K OGALE, *College of Engineering, Poona*

4 Production of nodular cast irons without employing standard malleabilizing cycles MR K C SOOD, *Messrs Metal Processing Industries, Calcutta*

5 Development of heavy duty parts of internal combustion engines by precision casting, lost wax and centrifugal processes PROF A VISWANATH, *Arthur Hope College of Technology, Coimbatore*

6 Designing and manufacture of a hot air engine proto-type of a low h p range for stationary use in which indigenous low-grade liquid and solid fuels can be employed PROF H A HAVEMANN, *Indian Institute of Science, Bangalore*

7 Development of gas turbine and jet propulsion units and the development of alloys to withstand high temperatures and stresses DR S R SEN GUPTA, *Bengal Engineering College, Calcutta*

8 Improvements in the method of synthesis of kellin to make the process commercially feasible, and synthesis of isomers and analogues of kellin PROF T R SESHADRI, *Delhi University*

9 Chemical investigation of Indian lichens with special reference to Himalayan varieties PROF T R SESHADRI, *Delhi University*

10 Investigation of Indian medicinal plants with special reference to *Prunus* and *Heracleum* species and *Holbaelia latifolia* and *H angustifolia* DR D CHAKRAVARTI, *University College of Science, Calcutta*

11 Synthesis of new anthraquinonoid and sulphurized vat dyes and study of their constitution and properties DR K VENKATARAMAN, *University of Bombay*

12 Mechanism of explosions in internal combustion engines DR R N TAWDE, *Royal Institute of Science, Bombay*

13 Survey of aromatic plants of India with special reference to citrus species MR S G SASTRI, *Bangalore*

14 Study of the nature of atmosphere study of the E-variations, classification of waveforms of atmospherics in relation to their origin, propagation of atmospheric disturbances, direction finding and location of thunderstorm centres, and study of the intensity variation with the frequency channel of the atmosphere DR S R KHASTGIR, *Banaras Hindu University*

15 Investigation on the preparation, testing and standardization of quartz oscillator plates DR S BHAGAVANTAM, *Osmania University, Hyderabad*

16 Crystal growth studies to develop a technique for growing large crystals DR R S KRISHNAN, *Indian Institute of Science, Bangalore*

17 Production of synthetic sapphires DR P K KICHLU, *Delhi University*

18 Design and development of electrodynamo meter type of ammeters, voltmeters and watt-meters, instruments for measuring temperatures of oil, carburettor, cylinder, etc, in aircraft DR N M ATHAWALE, *Poona*

19 Study of absorption and emission spectra of toluene DR R K ASUNDI, *Banaras Hindu University*

20 Doppler effect in positive rays DR B DASANNACHARYA, *Banaras Hindu University*

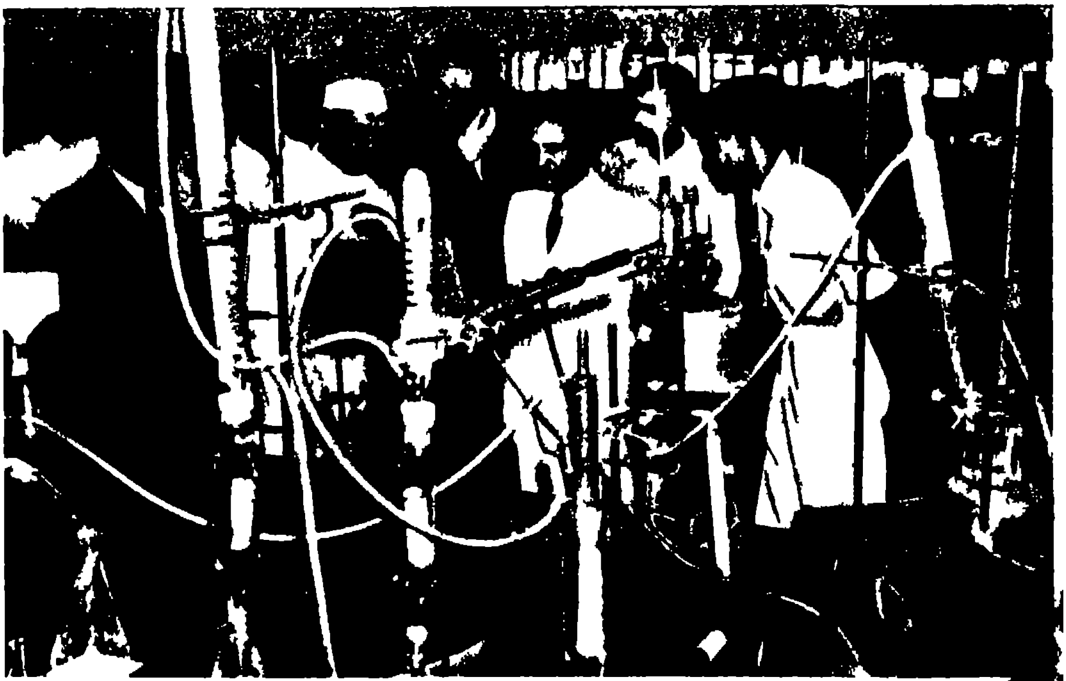
In addition to the above twenty new schemes, the Governing Body approved the renewal of 50 research schemes which are under investigation in various laboratories and research institutions

The Council has also instituted two research scholarships in industrial statistics

[illegible]

THE NATIONAL FUEL RESEARCH INSTITUTE DIGWADIH

Dr Rajendra Prasad addressing the gathering at the Fuel Research Institute



The Hon'ble Pandit Jawaharlal Nehru Prime Minister with Dr S S Bhatnagar Director Council of Scientific & Industrial Research going through the Fuel Research Institute Laboratories

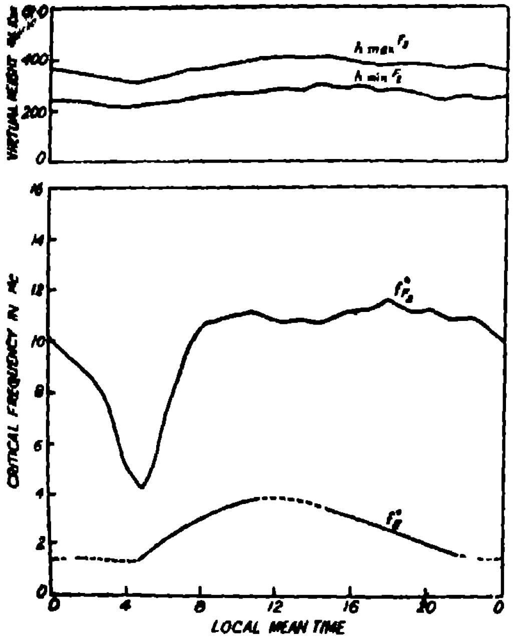
Characteristics of the Ionosphere over Calcutta (March 1950)

S S BARAL, R K MITRA, D C CHOUDHURY,
(MRS) T K BHAR & A P MITRA
Wireless Laboratory, University College of Science, Calcutta

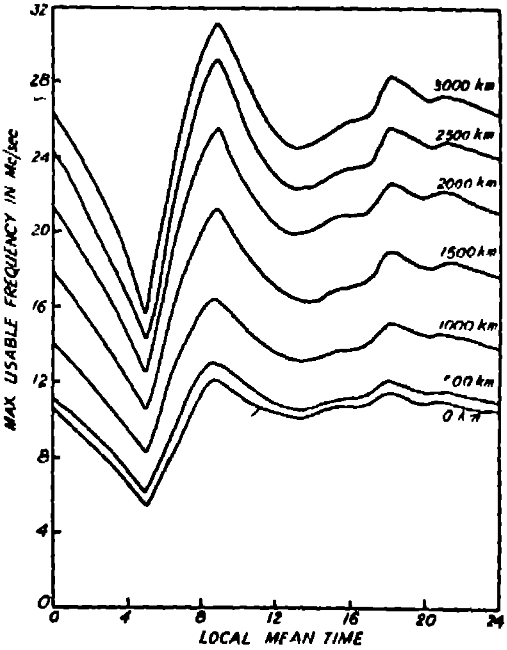
THE following are the ionospheric data observed at Calcutta for the month of March 1950

Fig 1 represents the mean hourly values of the penetration frequency of the E region and the penetration frequencies and virtual heights of region F$_2$ in graphical form The figures are obtained from the average normal values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of June 1950 Table I gives the different occasions during routine observations when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights

Sporadic E ionization was found to occur frequently during afternoon hours and sometimes during morning Throughout the whole month strong absorption of normal E echoes was noticed during the hours of noon like that in the previous month The behaviour of F region was found to be abnormal at night and a high value of ionization was maintained till midnight on most of the days



(5 HOURS 54 MINUTES AHEAD OF G M T)
FIG 1 — MARCH 1950



AT POINT OF REFLECTION
FIG 2 — PREDICTED M U F VIA F$_2$ LAYER, JUNE 1950

in textiles engineering and chemicals Field investigations are to be conducted at Bombay Ahmedabad Jamshedpur and Calcutta

A scholarship for training a student in India in the subject of Age Determination of Rocks was also sanctioned

One of the important recommendations made by the Council of Scientific & Industrial Research to the Government of India is the early setting up of a synthetic petrol plant in India The Council has recommended the acceptance of the project by *Messrs Koppers Inc* U S A involving a capital investment of Rs 22 crores This project will enable India to obtain 70 000 tons of aviation petrol per annum which would amply meet her requirements In addition about half a million tons of domestic coke and other valuable petroleum by products will also be produced

The Council has appointed a Committee consisting of Mr J R D Tata Mr G D Birla Seth Kasturbhai Lalbhai Lala Sri Ram Dr S S Bhatnagar Dr J C Ghosh and Dr D N Wadia to examine the project report of *Koppers Inc* and submit a report to the Cabinet for implementation of the project in the course of the next three years

The establishment of a second coal survey station in the Central India area at Kamptee to serve the Pench Wardha and Chanda Berar Valley and the Singareni coalfields in co operation with the Government of C P was approved by the Council

It was announced that the Government of India had decided to install an optical glass factory of 10 to 12 tons capacity adjacent to the Central Glass & Ceramic Research Institute Calcutta The factory will work under the technical guidance of the Institute

The Governing Body approved the amalgamation of the Indian Institute of Fruit Technology with the Central Food Technological Research Institute Mysore The Fruit Technology Institute was hitherto located in Delhi

An Expert Committee on Microseisms Sea Waves and Swells which will undertake the study of storms on the east and west coasts of India oceanography and related subjects was appointed

The research work so far carried out on hydrogenated vegetable oils under the joint auspices of the Council and the Indian Research Fund Association revealed that the prejudice against *vanaspati* was unjustified in view of the fact that it has not been proved harmful The Council approved the constitution of a joint committee of the Council of Scientific & Industrial Research and the Indian Research Fund Association to keep abreast of all developments in respect of hydrogenated fats and oils

The appointments of Dr Ernst Zipkes an eminent Swiss engineer as Director of the Central Road Research Institute and of Dr J H Truttwin A Swedish chemical engineer as Assistant Director Chemical Engineering Division National Chemical Laboratory Poona was approved by the Council

Characteristics of the Ionosphere over Calcutta (February 1950)

S S BARAL R K MITRA D C CHOUDHURY
(MRS) T K BHAR & A P MITRA
Wireless Laboratory University College of Science Calcutta

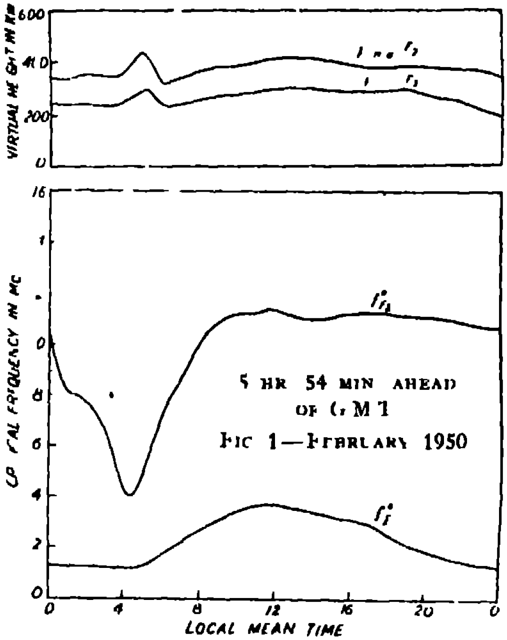
THE following are the ionospheric data observed at Calcutta for the month of February 1950

Fig 1 represents the mean hourly values of the penetration frequency of the E region and the penetration frequencies and virtual heights of region F_2 The figures are obtained from the average normal values of data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies for different distances of transmission by reflection at the F region over Calcutta for the month of May 1950 Table I gives the different occasions during routine observations when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights

Sporadic E ionization was found to occur frequently during afternoon hours and some times during early morning Strong absorption of normal E echoes was noticed during the hours of noon on most of the days in this month The behaviour of the F region was found to be abnormal at night and a high value of ionization was maintained till midnight on most of the days It may be noted that the F region abnormality may be due to the increased solar activity during this month

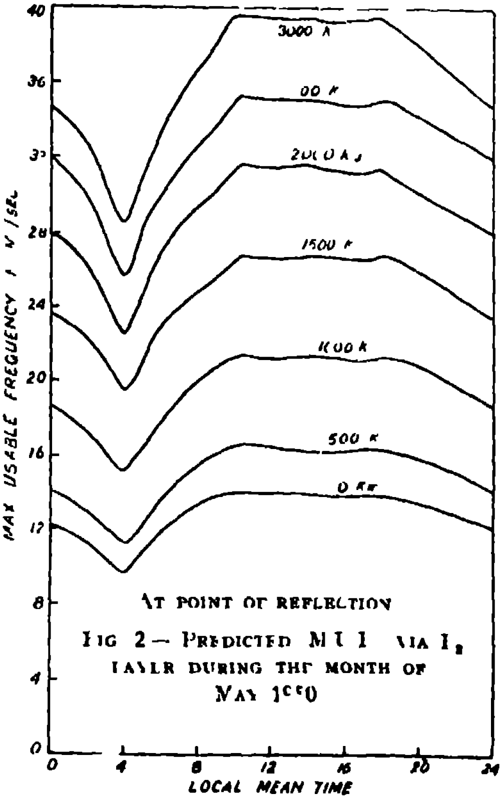
TABLE I

MONTH & YEAR	DATE	HOUR	f_{E_s} Mc	h_{E_s} km
February 1950	2	23 00	4 00	10
	3	00 00	00	105
		01 00	3 50	105
		17 00	3 10	105
		18 00	3 20	105
	6	19 00	3 45	90
		20 00	4 00	90
		21 00	4 2	90
	7	19 00	3 40	90
		20 00	3 00	90
		21 00	3 35	90
	8	04 00	4 25	90
		19 00	3 25	105
		20 00	3 40	90
		21 00	3 50	90
	9	07 00	2 40	90
	14	06 00	3 00	90
		08 00	3 50	105
		18 00	3 [illegible]	105
		19 00	3 40	90
		21 00	2 60	90
	15	08 00	3 50	105
		09 00	4 00	105
	17	06 00	3 60	90
		20 00	4 00	90
		22 00	3 25	90
	18	08 00	3 00	105
	21	18 00	3 35	105
		20 00	4 00	105
		21 00	5 00	105
	22	07 00	3 50	105
		18 00	4 00	120
		19 00	2 75	105
		20 00	4 25	105
		22 00	6 00	105
		23 00	3 00	90
	23	06 00	3 00	90
		16 00	4 05	120
		19 00	3 20	105
		20 00	3 30	105
		21 00	3 20	105
		23 00	3 35	105
	24	00 00	3 30	90
		17 00	3 20	105
	27	19 00	4 25	105
		20 00	3 00	105
		21 00	4 00	105
	28	08 00	4 00	105
		18 00	3 20	105
		21 00	3 05	90
		22 00	4 00	90



5 HR 54 MIN AHEAD OF G M T

FIG 1—FEBRUARY 1950



AT POINT OF REFLECTION

FIG 2—PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF MAY 1950

Semi-conductors & Crystals

K R DIXIT
Royal Institute of Science Bombay

IN the early days of the development of radio communications the crystal rectifier was almost universally used as a detector in radio receivers The crystal was fixed in a metal mount and the rectifying contact was made either by one of the sharp angles of the crystal pressing against a metal plane or it was made with a flexible wire cat whisker which was held in contact with the crystal Conductivity of the contact depends on the direction of the current Good rectification was obtained only from sensitive spots on the crystal and frequent adjustments of the contact point were necessary for good performance

The thermionic tubes gradually replaced the crystal rectifier first as diodes and later as triodes tetrodes pentodes etc The thermionic tube in the form of a diode and triode was used in the beginning only as a detector Later when the theory of thermionic tubes was better understood the possibility to use them as producers of oscillation became quite evident Now it is possible to use the thermionic valves for producing and detecting oscillations in the whole range of frequencies from about 6 metre waves used in television to about 500 metre waves used for broadcasting This development brought out clearly the difficulties in the use of thermionic tubes for producing and detecting short waves The difficulties arise from the inter electrode capacity and the time of transit of the electrons between the electrodes Both these the inter electrode capacity and the time of transit can be reduced by reducing the size of the tube But this reduction in size also reduces the power output of the tube The difficulties in the use of the thermionic tubes as producers of oscillations have been overcome by drastic changes in their design we now use either the split anode magnetron or the velocity modulated thermionic tubes for producing microwaves No design of a thermionic tube appears to be perfected to the same extent to enable us to use it alone in detecting microwaves It is here that the crystal rectifier steps in and shows that it is as important as the magnetron or the klystron Since the development of the microwave radar crystal rectifiers have been manufactured in millions for use as microwave detectors Its most extensive use up to now has been as a frequency converter in microwave reception where its performance has not been equalled The development of germanium rectifiers capable of withstanding relatively high inverse voltages indicates that it could replace vacuum tube diodes in wide band receivers and in a variety of other circuits The recent development of the transitor a semi conductor triode using a crystal of germanium indicates new possibilities The present trends appear to indicate that it may be possible at a not very distant date to use a suitable combination of crystals and semi conductors both for producing and detecting microwaves efficiently

The object of this paper is to give a short resume of the present development both experimental and theoretical of the subject and then to indicate some investigations which could be undertaken

Detectors (Experimental)

From about 1925 to 1940 the crystal rectifier was chiefly used as a laboratory devise for detecting and monitoring ultra high frequency power There was a simultaneous development in progress of the semi conductor rectifiers of the barrier layer type A typical barrier layer rectifier of the copper oxide type can be used over a very wide range of frequencies In the form of a battery charger it works at a frequency of 50 cycles/sec In the form of a heterodyne detector at carrier frequencies or as a modulator in the carrier system it works at frequencies of a few megacycles/sec In this field the practice has far outstripped our knowledge of the theory and we are forced to follow the trial and error and inferential methods of procedure It was supposed at one time that the presence of any impurity in copper affects the rectification adversely But it was shown by the author[1] that a suitable impurity properly included increases the rectification The same principle which applies to a semi conductor rectifier of the copper oxide type, applies to crystals like silicon Theuerer[2] discovered that a small amount of boron added to high-purity silicon increases its conductivity improves sensitivity and also makes the crystal highly resistant to burn out As a result boron-doping' is now widely used in silicon crystal manufacture

Southworth and King[3] used a crystal rectifier made of silicon crystal and a whisker of 8 mil tungsten, 2 mm long, as a microwave receiver in the range 10 to 15 cm At high frequencies the capacitance of the rectifying element and the transit time begin to play a dominant rôle so that it is very difficult to construct amplifier tubes which work satisfactorily at these frequencies Even the specially designed tubes like the Westinghouse 708A and the British CV58 diode were noisy and the noise output increased with frequency The M I T Radiation Laboratory designed and constructed tubes to work at a frequency of 3,000 M C per second (10 cm) The best of these is comparable in performance to superheterodyne receivers using crystal mixers However, these tubes are difficult to make and have not been manufactured on a mass-production scale and members[4] of the M I T Radiation Laboratory themselves admit that it is unlikely that a r f amplifier tube can compete with crystals at higher frequencies The superior performance of crystals led to further research and development and this has continued even up to the present time

Crystal rectifiers are available in the form of crystal cartridges which conform to standard specifications[5], both in regard to their test conditions and performance limits and also their external geometry The steps taken in preparing a high quality crystal rectifier are now well established First the material, silicon or germanium, is purified Then a controlled amount of selected impurity is added, ingots prepared and pieces of suitable size to go into the cartridge case cut The surface of these cut pieces is polished, etched and heat treated The whisker points of a suitable metal, usually tungsten, are cut, shaped and also polished These parts are assembled, adjusted and tested as to their performance The cartridge is then mounted in the mixer or crystal holder by means of a spring grip The cartridges are thus as readily replaceable as a tube

A typical characteristic curve of a silicon unit is shown in Fig 1 The forward current at 1 volt is 10 to 20 ma for a good mixer crystal In the back direction the standard crystal has a resistance of about 5,000 ohms at 1 volt The characteristic curves in the forward direction of several typical rectifiers are compared in Fig 2 Fig 3 shows the current-voltage characteristic of a typical germanium high inverse voltage rectifier made from an alloy containing 0 25 atomic per cent of tin The forward currents at 1 volt lie in the range 5 ma to 10 ma, and currents greater than even 100 ma may be passed in the forward direction In the back direction at 30 volts the resistance is in the range 10 000 ohms to 1 megohm The size of the contact area is rigorously controlled, as it determines both the effective resistance of the contact and its capacitance The capacity of the contact plays a very important part in the efficiency of rectification at high frequencies Usually the manufacturers adjust the rectifying contact for optimum performance

Copper oxide rectifier is made[6] by partially oxidizing a sheet of electrolytic copper to which a suitable impurity is added at about

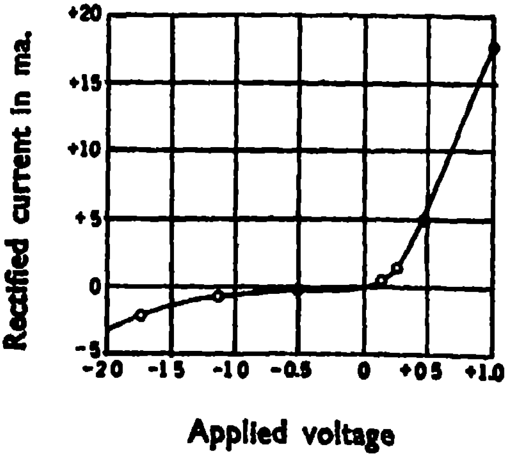


FIG 1 — A TYPICAL CHARACTERISTIC CURVE OF A SILICON RECTIFIER

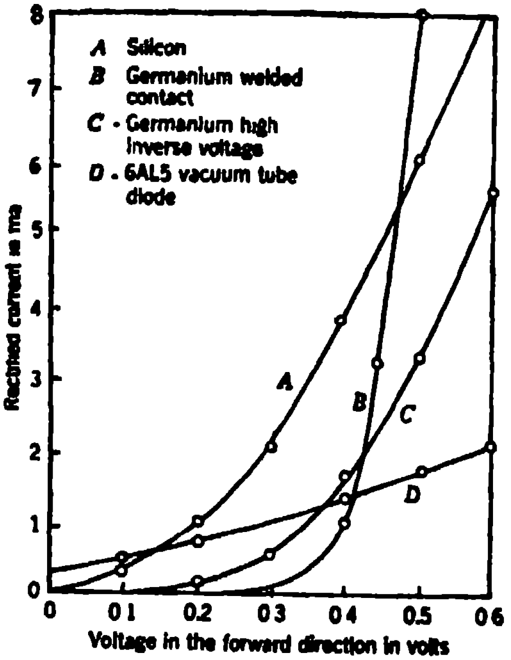


FIG 2 — A COMPARISON OF THE CHARACTERISTIC CURVES OF SEVERAL RECTIFIERS

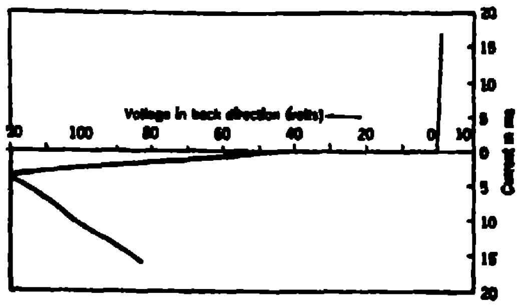


FIG 3 — TYPICAL CHARACTERISTIC CURVE OF A HIGH INVERSE VOLTAGE GERMANIUM RECTIFIER

1,000°C and then by allowing the oxidized sheet to cool to room temperature Then an efficient electrical contact is made with cuprous oxide and the rectifier element is ready for use The characteristic curves of these rectifiers are similar to those obtained with crystals and shown in Figs 1-3 As before, the most important electrical property of these oxide rectifiers is their capacity, which is of the order of 0 02 μF per sq cm The capacity has the effect of increasing the reverse leakage when the rectifier is used at high frequencies Further, as in the case of crystals, the electrical properties of the oxide rectifiers can be varied considerably by the mode of manufacture and the doping material used

Heterodyne reception enables us to convert the carrier frequency of a signal to a new value This is achieved with the help of a local oscillator The local oscillator output and the signal are coupled into a non linear device where they generate the sum and the difference frequencies This process of converting a signal from one frequency to another by combining it with a local oscillator voltage in a non linear way is called mixing The most important mixing process in microwave receivers is the conversion of a signal at a microwave frequency to one at relatively low frequency, say 30 mc /sec The non-linear device used in frequency conversion may be any type of detector or demodulator but in the hetero dyne reception of microwave signals, the crystal converter is used at present Thus it will be seen that crystal rectifiers play in microwave systems the same part as is played by copper oxide rectifiers in carrier telephone systems It should be noted that in the systems mentioned above both the crystal rectifier and the copper oxide rectifier are acting as mixers in heterodyne systems and are working at about comparable frequencies and with comparable efficiencies

Transitor — a Semi-conductor Triode

The transitor[7, 11] consists of a small block of germanium as the basic element, on which two point contacts are placed in close proximity on the upper surface One of these biased in the forward direction is called the emitter The second biased in the reverse direction is called the collector A large-area low resistance contact on the lower surface called the base electrode, is the third element of the triode The germanium used is of the *n* type and is the same as the material used in high back voltage germanium rectifiers The treatment of the germanium surface is also similar While different metals may be used for the contact points most work has been done with phosphor bronze points The ends are cut in the form of a wedge so that the two contacts can be placed together The actual contact area is probably ~ 10^{-6} sq cm

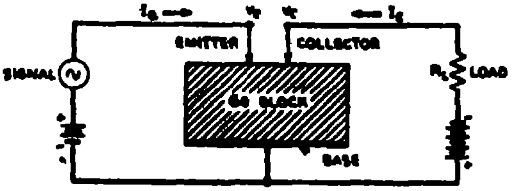


FIG 4 — SCHEMATIC OF TRANSITOR SHOWING CIRCUIT

The circuit in Fig 4 shows how the transitor may be used to amplify a small a c signal The emitter is biased in the forward (positive) direction so that a small d c. current of the order of 1 ma flows into the germanium block The collector is biased in the reverse (negative) direction with a higher voltage so that a d c current of a few milliamp flows out through the collector point and through the load circuit It is found that the current in the collector circuit is sensitive to, and may be controlled by, changes of current from the emitter An overall power gain of a factor of 100 (or 20 db) can be obtained in favourable cases

One of the important parameters affecting the operation of the transitor is the spacing between the point electrodes The emitter current has less and less influence on the collector as the separation S is increased Both $R_{21} = (\delta V_c/\delta I_e)$ when I_c = constant, and the current amplification factor $\alpha = (\delta I_c/\delta I_e)$ when V_c = constant, decrease with S The effect of the collector current on the emitter represented by the feed-back resistance also decreases with increase in S The current amplification factor α decreases approximately exponentially with S, it also increases with temperature but the change is not extremely rapid Measurements show that the overall power gain drops off between 1 and 10 mc/sec Estimates of transit time for the holes to flow from the emitter to the collector are of the same order These results suggest that the frequency limitation is associated with transit time rather than electrode capacities

A slight variation of the transitor in which the emitter and collector contacts bear on the opposite faces of a thin wedge or slab of semi-conductor is described by Shive[10].

Crystal Harmonic Generators

In the region of wavelengths represented by a few millimetres, no efficient magnetron or klystron oscillators are available at present. In this region it is usual to employ crystal multipliers operating on the second harmonic energy from klystron tubes as sources of power to cover the region 3 mm. to 10 mm These generators give relatively low power, only a few milliwatts, as compared to the few megawatts peak power generated by some magnetrons Yet if we remember that such millimetre waves are chiefly used in the field of microwave spectroscopy, it will be clear that this low power is not a particular disadvantage

Theory of Rectification

According to the zone theory[12,13], a semi-conductor differs from an insulator in the smaller energy difference between the completely filled electron band and the completely empty one It is possible that intermediate levels are provided between the filled and empty bands by the impurities which may be present The electrons are excited to move from the occupied to the vacant band either directly or through the intermediate levels A relatively small number of electrons present in a band moves freely and obeys the Maxwell-Boltzmann statistics If we have an electron band which is almost completely filled, the few electrons which are missing and which would fill up the band could be regarded as positive electrons or holes and it is observed that the movement of these holes obeys the Maxwell-Boltzmann statistics, whereas the electron gas is highly degenerate The calculations are thus much simplified by considering the few electrons in the relatively empty band (*n* type of conduction) and the few holes in the almost filled band (*p* type of conduction)

The crystals of silicon and germanium and barrier layers of the copper oxide type are semi-conductors A knowlegde of the electron distribution in a semi-conductor is essential to the understanding of the rectifying process Equilibrium number of electrons and holes can be calculated by the methods of Wilson[14,15] and Fowler[16], and is proportional to the exponential of $-\Delta E/kT$ where ΔE is the energy separation of the levels Besides the number of current carriers, other factors which affect rectification are the mobility of the current carriers and their mean free path. The mobility is influenced both by the lattice and by the impurities

The rectification in crystals takes place in the vicinity of the metal-crystal (semiconductor) contact In this region there exists a potential barrier, in fact the existence of a barrier layer at the contact is a necessary condition for rectification Such barrier layers are easily formed at a metal semiconductor contact and these rectifiers have been well developed It appears quite plausible to construct rectifiers of the metal-insulator type, but research in this direction will have to be undertaken before we get a successful metal-insulator rectifier

In the theory of barrier-layer rectification, we have so far three distinct methods of approach With a very thin barrier layer $\sim 10^{-7}$ cm, the passage of electrons across the potential barrier can be explained by the "quantum mechanical tunnel effect" This was the method adopted by Wilson[17] and by Nordheim[18] With thick layers $\sim 10^{-5}$ cm observed in copper oxide rectifiers, the methods of Wilson and Nordheim predict a wrong direction for the current For such layers the thickness of the barriers is large compared with the mean free path of the current carriers This type of rectification was explained by Mott[19,20] and by Schottky[21,22] by a sort of diffusion theory It was later shown by Sachs[23] that equations of the diffusion theory have to be modified by the inclusion of a term involving the mean thermal velocity of the current carriers But as the layer in this case is much thicker than the mean free path of current carriers, collisions must occur in the barrier and we are forced to conclude that movement of current carriers in the barrier is a statistical process This was the conclusion arrived at by the author[1] experimentally In the statistical method of approach, we shall have to tackle the problem by the same formal mathematical procedure as is applicable to a discharge tube working at low pressures The third method is applicable to barrier layers of intermediate thickness $\sim 10^{-6}$ cm Such layers are observed in the case of silicon and germanium, they are produced on the surface during the process of polishing and heat treating The electrical properties of the thin surface layers are different from the bulk material. This layer $\sim 10^{-6}$ cm is thick enough to reduce considerably the number of electrons which penetrate the barrier by the "tunnel effect", at the same time it is thin enough to permit us to neglect the collisions within the barrier The movement of current carriers is now easier to handle mathematically, and is similar to the movement of electrons in a vacuum tube diode[21,22] The diode theory could be applied even when some collisions occur within the barrier In its simplest form, the diode theory assumes that the distribution of the electrons is governed by the Maxwell-Boltzmann law Then we calculate the number of electrons dn which cross unit area per unit time, then the number of such carriers which possess sufficient kinetic energy to overcome the potential barrier, and finally we calculate the effective current which is the difference of the current from the metal to the semiconductor and the current from the semiconductor to the metal The current density is given as

$$j = \tfrac{1}{4}\, ne\,\bar{v}\, \varepsilon^{-\frac{e\phi_0}{kT}} \left(\varepsilon^{\frac{eV}{kT}} - 1 \right)$$

where ϕ_0 is the contact potential difference, V is the effective applied potential across the barrier and other letters have their usual significance

In this simplest form the current density formula is comparable with that obtained by the diffusion theory, the only change being the substitution of another velocity function for $\bar{v}/2$ This simple theory has been improved upon by Bethe[24] and by others[26-29] by considering the image forces, the space charge and the leakage of electrons by the tunnel effect The effect of the image forces as well as the tunnel effect is to lower the contact potential barrier and thus reduce ϕ_0 The effect of the space charge and undesirable impurities is to produce small local variations of ϕ_0 These small changes in ϕ_0 generate noise in crystal rectifiers

Rectification at High Frequencies

We have as yet no satisfactory theory of rectification by the semi-conductor contacts at microwave frequencies Our knowledge of the theory[30-33] is only qualitative but still we have a fair idea of the factors which affect rectification. At microwave frequencies the capacity of the barrier layer begins to play a prominent part, and at times the normal back resistance could be neglected as compared with the capacitative reactance Rectification, therefore, can be improved by using a small contact point but very small values of the contact radius lead to mechanical and electrical instability Another important factor at high frequencies is the polarization of the medium At high frequencies the consideration of polarization leads to the study of time lags and relaxation times[32,33] All such points must be considered suitable assumptions made and a satisfactory theory of rectification at high frequencies developed as rapid progress in this field apparently awaits such a theory

Working of a Transitor

A complete quantitative theory of the action of a transitor is not available as yet Qualitatively[11] the action of a transitor can be explained in terms of the typical properties of a semi conductor namely that the semi conductor current is partly due to electrons and partly to holes The germanium used in the transitor is of the *n* type that is the conduction in the body of the block is due to electrons acting as carriers of charge The specimens usually carry 5×10^{14} conduction electrons per c c In contrast to the current in the body of the block the current from the emitter is composed in large part of the holes (i e carriers of opposite sign to those normally in excess in the body of the semi conductor) The collector is biased in the negative direction In the germanium the current flowing towards the collector creates an electric field and this field < > attracts the holes flowing from the emitter The emitter and the collector are very close so that almost the entire hole current from the emitter flows to the collector and into the collector circuit The collector contact opposes the electron current but allows the hole current to flow towards it The hole current flowing to the junction alters the space charge in the barrier layer and this increases the change produced in the collector current As a matter of fact it may be said that the hole current from the emitter modifies the current voltage characteristic of the collector Thus there is a voltage gain and a power gain of the input signal These changes are usually accompanied by a current amplification

The above theory only gives a general picture of the way the transitor operates and many problems — as is natural for a new device — yet remain unsolved

Some Suggestions

It could be reasonably expected that the development of crystal rectifiers will follow a course not dissimilar to that followed by the development of thermionic tubes The thermionic diodes were used in the beginning only as receivers of radio waves Triodes were then developed first as receivers and later as transmitters of radio frequency waves Similarly crystals were used in the beginning for detecting the radio waves later on their range of performance was extended in the form of superheterodyne receivers for microwaves using crystal mixers And only recently it is found possible to use the crystal in the form of a transitor which is essentially a semi conductor triode

The future scope of work appears to lie in the direction of improving the efficiency and the range of action of crystal diodes their development in the form of triodes and their subsequent use in producing directed high frequency oscillations All these improvements however are only possible after we have a satisfactory theory of the crystal diode and the transitor action A less ambitious programme would be to investigate experimentally the characteristics of the different metal insulator junctions and their efficiency as rectifying layers It is also possible to undertake investigations on the preparation of triodes of the transitor type from copper oxide or selenium barrier layers

It must be remembered that all these problems are essentially dependent on the part played by electron traps Therefore it may be desirable that such studies on the rôle of electron traps in semi conductors are closely associated with similar studies of the rôle of electron traps in luminescent solids or photographic emulsions

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Dr. Ernst Zipkes, Director, Central Road Research Institute, Delhi

Dr Ernst Zipkes formerly Head of the Department of Road Research Federal Institute of Technology Zurich (Switzerland) has been appointed Director of the Central Road Research Institute Delhi He will take charge of his duties on 26th May 1950

Dr Zipkes received his technical education at the Institute of Technology Berlin and later at the Federal Institute of Technology Zurich He was awarded the Doctorate of Technical Sciences in consideration of his investigations on Frictional characteristic as a criterion in the evaluation of road surfaces

He worked in the Department of Railway and Road Construction of the Federal Institute of Technology Zurich from 1935 to 1940 In addition to his normal teaching work he carried out many important investigations on problems of road research and planned and equipped the Department of Road Research of the Institute the scientific work of which he has directed with conspicuous ability since 1940 He was consulting engineer to many commercial firms municipal authorities and the Federal Government He has travelled extensively in England and Holland studying the methods of road and runway construction as well as research and traffic problems in those countries

Dr Zipkes s research activities cover a wide range of problems Noteworthy among them is his work on the importance of frictional characteristics in (1) the evaluation of the construction surface texture and safety of road surfaces (2) effects produced in road surfaces by steel tyres and tyres tread tracked vehicles road rollers and horse traffic (3) measurement of road surface texture (4) friction and skidding safety in road traffic (5) behaviour of runway surfaces and (6) performance of snow-clearing machines He is the author of numerous research memoirs published in Switzerland and other countries

Dr Ernst Zipkes

Production of High Purity Electrolytic Manganese Dioxide — Literature Report No. 7

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National Metallurgical Laboratory C S I R, Jamshedpur

MANGANESE dioxide is chiefly used in the manufacture of dry cells It is also used as an oxidizing agent and catalyst and also in glass and ceramic industries in limited quantities The world s total consumption of manganese ores per year is over three million tons about 10 per cent[1] of which is produced in India 90 per cent of this amount is used by the steel industry and the rest is used mostly as manganese dioxide for other purposes India with her extensive deposits of rich manganese ores in Central Provinces Bihar Orissa Bombay Madras and Rajputana is deeply interested in the manganese industry as a whole

Production of good quality manganese dioxide for use in dry batteries is an important industry Natural pyrolusite contains various impurities and does not always contain enough manganese dioxide to suit the requirements of the dry cell industry Attempts have therefore been made to obtain a pure product by processing natural ores

Chemical Methods

The *I G Farbenind*[2] process for the manufacture of manganese dioxide involves the heating of the lower oxide of manganese to 250° to 600°C in the presence of excess of oxygen Oxides of manganese obtained by heating the carbonates and bicarbonates at 250° to 450°C may be used for the purpose The purity of the products is 90 per cent

It has been shown by Kato and others[3-5] that the temperature of reaction can be lowered and the quality of the product improved by heating the raw material with alkali catalysts The oxidation is brought about at 300°C Detailed investigations of Kakabadze[6] reveal that the higher the percentage of alkali used the higher is the conversion to manganese dioxide and the time required for the completion of reaction is also lowered 90 to 120 min suffice to complete the oxidation with 4 to 6 per cent addition of caustic soda or caustic potash the latter being more effective Calcium oxide magnesium oxide barium peroxide carbonates of potassium sodium calcium magnesium and barium are less effective Temperatures above 350°C are either unfavourable or fail to increase the yield The product obtained is washed with dilute acids and water to remove the alkali[7-9]

A better product more suitable for dry cells can be obtained by heating pyrolusite with bleaching powder in closed vessel[10] The manganese dioxide produced is washed with water to remove soluble salts

All these processes are inapplicable to low manganese ores For such ores it is advantageous to extract the manganese by sulphurous nitrous or hydrochloric acids and then oxidize the manganous oxide to dioxide According to Libby[11] manganese sulphate obtained after extraction is mixed with magnesium nitrate and heated to precipitate the dioxide Jacobs[12] describes a method in which hydrochloric acid is employed as the extracting agent and the chlorine which remains partly in solution (evolved as a result of the interaction between pyrolusite and hydrochloric acid) is utilized for oxidation during the dilution of the filtered solution for bringing about the hydrolysis The manganese dioxide obtained is pure In Volfson s process[13-15] the chlorine evolved during the solution of manganese ores is collected and the manganous chloride solution after removal of impurities is rendered alkaline with caustic soda to precipitate out manganous hydroxide which is then oxidized to dioxide by chlorine Air also has been used to oxidize the manganous hydroxide suspension in water[16,17]

Electrolytic Methods

The product obtained by chemical methods is not always free from impurities and the manganese dioxide content is not always high It has been shown that manganese dioxide produced by the electrolytic method is of high purity and its use ensures long life to dry cells Electrolytic methods are, therefore, gaining ground The general procedure is to reduce the manganese ores by carbon, producer gas or some mineral oil at high temperature The reduced ore is then treated with acids, commonly nitric or sulphuric, and the solution obtained is purified and filtered The solution is electrolysed between special electrodes under suitable conditions so that manganese dioxide is deposited on the anode

Electrolyte — Both nitric and sulphuric acid solutions can be used for electrolysis successfully Hydrochloric acid solution has not given encouraging results Use of nitric acid, however, is a little more expensive Dean[18] describes a method for extracting manganese from ores by nitrogen dioxide (NO_2), the resulting manganous nitrate solution being then heated by A C electrolysis to obtain manganese dioxide Naoto Kameyama[19], following the same principle of A C electrolysis, reports preparation of manganese dioxide of 92 to 100 per cent purity from 10 per cent manganous nitrate solution The sulphate bath has been employed by many workers The comparative advantages and disadvantages of the two baths are not very clear For D C electrolysis the concentration of acid is kept high In the case of nitrate bath, the concentration of manganous nitrate is 10 per cent with 2 to 3 per cent excess of nitric acid , with sulphate bath, the concentration of sulphate is 5 to 30 per cent , with neutral or low acid electrolytes the deposit of manganese dioxide contains lower oxides of manganese[20] Data on the effect of varying the concentration of manganese salt in the electrolyte are meagre The temperature of the bath is important and it is advisable to keep it high to improve current efficiency Graphite anodes are corroded at high temperatures

Voltage — It has been shown by Geleso and others[21] that high potential favours the formation of a product richer in manganese dioxide At the same time, the current efficiency is lowered and carbon and graphite anodes are easily attacked[22] The voltage recommended for sulphate bath is 2 5 to 4 5 volts

Current Density — Cells producing manganese dioxide can be operated between current densities of 0 005 to 1 0 amp per sq cm depending on the anode material Platinum electrodes require low densities while lead and carbon electrodes are best used at high current densities[23, 24]

Electrode Material — Choice of a proper electrode, particularly the anode, seems to be a knotty problem Considerations regarding the quality of product, ease of operation and trouble-free service lead to the choice of platinum electrodes for the purpose It is rather too expensive to be used for commercial purposes Peter Marx[25] has carried out experiments with graphite, lead and platinum electrodes With graphite cathode and hard-lead anode (containing antimony), and with 2 5 volts between them, the current efficiency was 70 per cent at 90°C With platinum anodes and a bath voltage of 3 volts, the current efficiency was lower but the product was 92 per cent pure With graphite anode the current efficiency went down to 55 per cent and the anode was corroded Ten different metals and alloys have been tested for suitability as anodes and the following were found unsuitable Mo, W, Mo Ni, 75 per cent Ferro-Si, 50 per cent Ferro-Si, Mo Si and stellite (Co-Cr-W) Storey and his co workers[21] have attempted to overcome anodic corrosion by controlling the applied potential They have shown that low potentials and low acid baths exert less corroding action on anodes

Effect of Addition Agents & By-products — Magnesium sulphate when present in the electrolyte (about 0 1 per cent) depresses the voltage required for decomposition The main reaction during the electrolysis may be represented by

$$Mn^{++} + 2H_2O = MnO_2 + 2H^+ + H_2$$

The acid which is thus produced may be utilized to dissolve fresh charges of reduced ores and the process can be made a continuous one

Use of Diaphragm — Particularly when the cell operates at high temperature, diffusion forces become considerable and due to catholyte coming into contact with anolyte, cathodic reduction occurs and energy is wasted Zaretskii[24, 26] suggests the use of a nitrated cloth diaphragm for preventing the mixing

Large-scale Production — It will be seen from the above that electro-chemical methods can be used to furnish high purity manganese dioxide free from undesirable impurities Production of electrolytic manganese dioxide on a pilot-plant scale with platinum electrodes has been started by *Electro-manganese Corporation*, U S A

Manganese Dioxide for Dry Cells — Although high-purity manganese dioxide generally improves the quality of dry cells, there seems to be no precise knowledge as to what really makes a sample of manganese dioxide a good depolarizer Kaneko and others[27] report that the e m f and capacity of dry cells bear no relation to the MnO_2 content of the dioxide sample On the other hand, Naoto Kameyama[19] showed that cells prepared from high-purity electrolytic manganese dioxide are not subject to self discharge and give a long flat discharge curve Shinzo Okada[29] reports that suitability is dependent on the oxygen content of the dioxide sample According to Kaneko[27], grain size of manganese dioxide has some influence on e m f and artificial manganese dioxide, which has a crystal structure different from natural manganese dioxide, is a better depolarizer Support for these views comes from Iliniskii[30] and Earl Otto[31] According to Makino[32] and Rossetti[33], the greater the loss on heating of a sample of manganese dioxide, the greater is its efficiency Presumably this loss refers to the water of hydration According to Verman and his co-workers[34], the presence of iron within limits is beneficial for LecLanche cells The criterion for a good depolarizer has not been formulated with any precision

Investigations on the factors affecting the purity of manganese dioxide obtained by electrolytic methods have been undertaken at the National Metallurgical Laboratory It is proposed to investigate also the influence of crystal structure and grain size of manganese dioxide, and of water of hydration and addition agents, on the life and quality of dry cells.

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Antioxidants in Science & Industry

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(*Continued from page* 127, *April* 1950)

Foods & Food Preparations

IN this connection, it will not be out of place to point out the difference between the meanings of the two terms " antioxidants" and "preservatives", as used in scientific literature The term " antioxidants " is confined to only those agents which can prevent oxidative deterioration, whereas all the agents which can protect materials from any kind of deterioration — oxidative, catalytic, enzymatic or bacterial — can be grouped as preservatives

Foods and food preparations are mostly spoiled by the activity of some one or more of the spoilage agents like enzymes, bacteria, molds, yeasts, etc For preventing this sort of spoilage, various preservatives are known Cases are also very frequent, especially with foods containing fair amounts of fat, which are spoiled due to atmospheric oxidation The spoilage of foods is usually accompanied by the loss of certain essential vitamins present in them The spoilage resulting from oxidation can be checked to some extent if the foods are sealed under an inert gas During the past few years, several authors have emphasized the necessity of using antioxidants in various food products which are prone to oxidative deterioration Cereal flours[69] and their extracts in suitable forms are being increasingly used in food preservation. These antioxidants have drawn special attention, because they are themselves food materials of bland odour, absolutely non-toxic, palatable and available at low cost Antioxidants prepared out of oat flour are usually marketed under the trade name " Avenex "

Most of the antioxidants which normally protect fats and oils are also capable of protecting fatty food materials from destructive oxidation To cite a few instances, cereal flours[71], particularly oat flour and their extracts, ascorbic[71b,l,72] acid and tyrosine[71e] and its more soluble esters have been very useful in retarding off-flavour development and promoting good keeping quality in milk and various milk products, viz butter, dried whole-milk and skim-milk powders, ice-cream, etc Several other fat-containing materials like dehydrated meat, fish, etc , can be preserved against destructive oxidation of the fats by the use of oat meal[71f,h,73], ethyl gallate[74], gum guaiac[74,75], or a mixture[76] of lecithin and sugar, etc Packing in dry oat meal helps to retard rancidity in nuts[71f,h] Potato-chips[71f,h,77] can be preserved by the application of oat flour as surface dust Dried eggs are preserved by incorporating a small amount of cysteine hydrochloride[78] in the egg-pulp before drying Oat flour[71f], betaine[79] or a betaine ester is effective in retarding the development of oxidized flavours in coffee[80]

Fruit juices (viz of orange and grape) and various other beverages also require antioxidants like corn[81] or oat[82] extract, lecithin[83], ascorbic acid[84], etc , for the control of oxidative deterioration and to increase the period of retention of the normal taste and flavour The browning of apples and other fruits, particularly when cut and sliced, is caused by oxidation and can be retarded by the use of thio-urea[85], glutathione[86], cysteine hydrochloride[86], etc An oat product[87], in combination with sugar, has also been used for the preservation of candies, jellies, biscuits and similar products The use of triethanolamine[88] as an antioxidant to prevent discolouration in lettuce heads packed for shipment or for storage is also known

Sometimes, instead of incorporating antioxidants in the foods, antioxygenic paper[89] or paper-boards suitable for wrapping or packaging food products are used Maize-flour paste[90] coated on vegetable parchment wrapping paper retards the oxidation of butterfat and lard Samples of butter packed in oat[71f] or maize-flour[90] treated parchment paper also undergo less oxidation The method[91] of coating the inner surfaces of tin cans for holding various foods with a thin film of corn or soya-bean flour extract is also known

Essential Oils & Perfumes

Essential oils are more or less susceptible to atmospheric and photo-chemical oxidation with the result that they tend to deteriorate in colour and perfume and to lose their active constituents on storage The changes are naturally rapid under the warm tropical conditions The crude oils containing resinous impurities are comparatively more stable than the purified oils

It is necessary to add small quantities of some potent antioxidants to essential oils to prevent their undesirable deterioration Very little work has been done in this field The importance of the use of suitable antioxidants in turpentine oils has been shown[92] Pyrogallol and hydroquinone have been found to be capable of preventing oxidation of turpentine oils[93] for a considerable length of time A mixture of wheat-germ oil and hydroquinone is very effective in retarding the oxidative deterioration of lemon and orange oils[94] and in maintaining their original flavour and colour Addition of catechol to peppermint oil[95] can prevent the loss of its chief constituent, menthol, for a long period Pyrogallol or ethyl gallate, in association with citric or tartaric acid, has been found to afford significant protective action against the autoxidation of lemon-grass oil[96] and the concomitant loss of its chief constituent, citral Chlorophyll also has been mentioned as a suitable antioxidant for citral[45] Crude cane or beet sugar[97] has stabilizing action on essential oils Combinations of antioxidants such as (1)[90a] those of a phosphorus compound and a polyhydroxy benzene or (2)[61] of a sugar and a phenolic compound, etc , have been found to exert synergetic action on the stabilization of essential oils

An antioxidant for an essential oil must be sufficiently soluble or dispersible in it and must not affect its normal colour and flavour The question of the use of toxic or non-toxic antioxidants in essential oils should be considered according to the specific application for which they will be designed

The use of antioxidants in perfumery for the retardation of fading of perfumes[98] is also known

Soaps & Cosmetics

The development of rancidity in soaps is associated with certain oxidative changes which usually occur when soaps containing high percentage of unsaponified fat or oil are kept exposed to atmospheric conditions, in contact with water, moisture or metals The deterioration in colour and perfume of toilet soaps with the development of rancid odour is very objectionable In order to overcome these changes, all high-grade soaps should be fortified with antioxidants Some of the antioxidants which have drawn attention as possessing the property of stabilizing soaps against rancidity and discolouration are aryl-substituted thio-ureas[91], mercapto-pyrimidine compounds[100], α-stannic acid[101], and condensation products[102] of amidines with alkylene oxides, etc Some antioxidants for rubber and hydrocarbon oils have found application in the preservation of soaps also, e g octylphenols[13] and ethers thereof, tertiary alkyl-substituted *O*-dihydroxy benzenes[23], phenyl-naphthyl-amines[103], etc

Antioxidants for toilet and medicinal soaps must be non-toxic and non-irritating

Cosmetic and therapeutic creams and lotions require the help of antioxidants for combating their oxidative deterioration An antioxidant for a cream (1) should preferably be soluble in the oil phase and insoluble in the water phase , (2) should be compatible with all other ingredients in it, (3) must not change the characteristics of the finished product . (4) must be non-toxic and non-irritating and (5) should be practically odourless and colourless Peru-balsam[104], tolu-balsam[104], guaiacum resin[105], etc , are potent antioxidants, particularly for oil-in-water creams

Paints & Varnishes

The rate of drying and setting of an oil film is associated with the absorption of oxygen from the air, which naturally increases in presence of heat and light and in the case of a highly unsaturated oil In the oxidation of drying oils, two periods may be distinguished (a) the formation of initial oxidation products, when the oil dries and sets to an elastic film and (b) further oxidation and destructive decomposition of the initial oxidation products into acidic and other degradation compounds, when the film becomes hard and brittle

The drying of paints and varnishes is accelerated by the addition of metallic " driers " The presence of driers, however, especially when in excess, besides hastening the initial oxidation changes and helping quick drying and setting of the film, may carry the oxidation too far with the result that the dried film may lose its elasticity and pliability, become hard and friable, develop cracks or wrinkles and finally may suffer complete disintegration These changes are rapid and prominent in the case of paints exposed out of doors to sunlight in summer The driers may also cause a greater degree of "skinning" in stored paints and varnishes

These disadvantages may be largely overcome and the life of an oil film may be prolonged by the judicious use of an optimum concentration of driers along with suitable antioxidants The influence of small quantities of some antioxidants may bring about the desired result They may not affect the quick drying of the oil but may retard the "progressive oxidation" or "super-oxidation" of the dried and set films so that the initial oxidation products may not undergo further change and the coatings may have greater elasticity and durability against the formation of crackings or wrinklings Besides, the presence of antioxidants may retard the oxidation and improve the resistance to skin formation during storage of paints and varnishes.

Some of the typical antioxidants which control oxidation in paints and varnishes are heptaldoximes[106], hydrocarbon-substituted carbamonitriles[107], polyhydroxyl-substituted naphthalenes[108], phosphoric esters[109] of polyhydric phenols, secondary amines[110], diazoaminobenzenes[111], aliphatic or aromatic substitution derivatives[112] of hydroxylamine oxime, polynuclear phenols[113] and nitration and sulphonation products thereof, alkyl-substituted hydroquinoline[114], alkylated polyhydric phenols[115], hydro-acridines[116], alkylated lead phenolates[117], etc

Synthetic resins, especially "phenolic resins", are largely used in the manufacture of paints and varnishes The use of such resins has been reported[118] to have antioxygenic influence on linseed oil even in presence of driers

Textile Oils

"Textile oils" are employed for a variety of purposes, e g. in the treatment, spinning and weaving of cotton, linen, wool, silk fabrics, , etc. "Wool oils" deserve special consideration in this connection

The fatty oils, being perfectly saponifiable, can be easily "scoured" out of the fibres and hence fulfil one of the prime requirements of wool oils These oils, however, especially the drying oils, have the tendency to absorb oxygen rapidly when exposed to air in thin layers under tropical conditions This absorption of oxygen by oils is usually accompanied by the development of heat Thus, in using a fatty oil, particularly a drying oil, for oiling wool, as the oil is exposed in thin layers to the air and as the amount of surface exposed is very great, the absorption of oxygen may be greatly accelerated with the result that under favourable conditions the heat developed may rise so high that the wool may be charred and in extreme cases may even burst into flames spontaneously The prevention of this spontaneous combustion in oiled fibre is of great practical importance in the use of fatty oils in textile mills where there are always large masses of loose cotton, wool, etc , lying about in heaps

Olive oil, being less susceptible to oxidation, is used as a wool oil, but as it is costlier, its use is confined to the manufacture of only high-class materials Other cheaper fatty oils also may serve the purpose of high-grade wool oils, if, of course, their tendency to oxidation is prevented by incorporating powerful antioxidants in them Preliminary researches[119] on the efficiency of antioxidants on the inhibition of oxidation in textile oils and on the retardation of spontaneous combustion in oiled fibres suggest the importance and commercial possibilities of stabilized oils in the textile industry The addition of oil-soluble stannous compounds (oleate, stearate, benzoate, etc) to textile oils has been shown[120] to have good effects on the retardation of oxidation of the latter A good deal of work remains to be done on selecting a suitable textile oil and its fortification with an effective antioxidant

Other factors which affect the selection of a suitable antioxidant for textile oils are (1) its effect on the colour of the oil , (2) its solubility in the oil , (3) its action on the fibre, dyed or undyed, and (4) its volatility

Pharmaceutical Preparations

Pharmaceutical preparations which gradually lose their potency due to oxidative deterioration can be stabilized by the use of suitable antioxidants

Antioxidants can prevent the oxidative deterioration of hormone preparations. Pituitary-hormone preparations[121] are protected against oxidation by the addition of some phenolic compounds like hydroquinone, pyrogallol, etc Natural substances[122], e g hesperidin-free extract of ripe oranges, certain biological fluids[123], particularly the aqueous humor of mammals, certain phenolic compounds[124], etc , can inhibit the autoxidation of adrenaline Certain phenols[124] which act as antioxidants towards the oxidation of adrenaline *in vitro* also sensitize *in vivo* the smooth muscles to adrenaline and to sympathetic excitations

In recent years, attempts have been made to arrest oxidative degradation of penicillin A few antioxidants like hydroquinone, ascorbic acid, etc , have been tried[125], but not much success has been achieved A good deal of work remains to be done in this field

The oxidative deterioration of pyrethrum and rotenone insecticides[126] can be inhibited by the addition of pyrogallol, hydroquinone, thymol, naphthylamine, etc

Certain fixed and essential oils are widely used in medicinal and antiseptic preparations Fortification of such preparations with suitable antioxidants to prevent the oxidative deterioration of the oils is of great practical importance

Miscellaneous Industrial Products — Dielectrics

Chemical stability is one of the major problems in dielectric work The retardation of the oxidative tendency under the local high temperature of the petroleum insulating oils and other insulating materials like rubber, resins, etc , is of great practical importance The development of satisfactory antioxidants for use in oxidizable insulating materials present to the chemist a means of approach in his attack on the problems of an improved high-voltage dielectric[127] An antioxidant for dielectric, however, must be studied not only from the standpoint of its efficiency in arresting oxidation, but also from the standpoint of its own dielectric stability

Lubricating Greases

Stability of grease in storage and especially in service is important Greases containing poor quality fats are likely to turn rancid and to change colour due to oxidation Excessive amounts of free fats or free fatty acids in the finished grease are likely to promote these changes Even high-grade greases tend to deteriorate under high temperature and high-speed conditions and may develop high acidity that may have corrosive action on metal bearings The oxidation of greases can be retarded by the addition of suitable antioxidants, e g aminosalicylic acids[128], esters[129] of a higher fatty acid and a polyhydric alcohol, etc

Dyes

The undesirable fading of many dyes and pigments is due to some oxidative changes Hence, the fastness of these dyes may be increased by the addition of antioxidants Hydroquinone, thio-urea, etc , have been found to exert a protective action on some dyes[130]

Bitumens

A fatty residual pitch, viz stearin pitch or wool-grease pitch, is used with bitumens[131], viz asphalt, to inhibit oxidation

Other Autoxidizable Organic Compounds

Many organic compounds containing olefinic linkages oxidize spontaneously on exposure to atmospheric conditions The use of antioxidants for arresting the autoxidation of unsaturated fatty acids[41], their esters and unsaturated hydrocarbons[132] is known

Aromatic amines[133] can be protected from autoxidation during storage by the addition of antioxidants like inorganic compounds of sulphur, e g sodium thiosulphate

Aldehydes, particularly benzaldehyde, are prone to autoxidation on keeping Dihydric phenols[134], derivatives of hydrogenated glyoxaline[135], diamino-ethanes[136] or their derivatives, thio-urea[137] or allyl-thio-urea can retard the autoxidation of aldehydes.

Autoxidizable aromatic or heterocyclic bases[138] or their solutions are protected from oxidation by addition of an organic compound containing one or more SH- groups, e g thio-glycolic acid

Sodium sulphite or other sulphites are effective in preventing the oxidative discolouration and decomposition of tannic acid[139] solutions.

Polyphenols, amino-phenols, aromatic amines, etc , have been reported to be very effective in retarding the autoxidation of diethyl ether[140].

Similar use of antioxidants to prevent the oxidative degradation of a few other organic compounds is also known

A perusal of the above literature will reveal that antioxidants possess an outstanding practical bearing in the development of science and industry Although hundreds of patents on the use of varieties of antioxidants have appeared, much work remains to be done on the application of antioxidants under practical conditions in various articles, especially in foods and vitamin preparations so as to maintain their nutritive value and to avoid undue spoilage

Lastly, it is desirable to point out some of the general principles governing antioxygenic action, which are of practical importance The action of antioxidants is specific in nature The difference in the physical state may have a profound influence on the efficacy of one or other added antioxidant The action of a given antioxidant will vary with different substances under the same conditions or with the same substance under different conditions The same compound may be antioxygenic towards some materials and almost inert or even pro-oxygenic towards others Hence, the use of even a well-known antioxidant should be followed only after the most stringent tests of its efficiency under practical conditions and in the particular medium in which it will be designed to be incorporated The exact mechanism of the action of antioxidants as also of their synergetic action is not yet fully understood The antioxidants may first use up the oxygen or they may break the chain in the series of reactions that take place during oxidation In fact, it is very difficult to explain satisfactorily from a theoretical standpoint all the existing results of the application of the innumerable antioxidants in practice There is scope for carrying out extensive research in this field

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Central Road Research Institute, Delhi

The Central Road Research Institute, which will concern itself with investigations on roads — road surfacings, methods of construction, improvement of rural vehicles, and problems of road safety — will soon start functioning at Delhi Transport is a problem of major importance in India, and the need for expanding our inadequate network of roads, for improving the existing roads to carry a greater volume of traffic, and for constructing rural roads, is manifestly urgent Investigations which will be carried out in the Central Road Research Institute are expected to provide the knowledge basic to the improvement of road conditions and traffic facilities

The main object of the Institute is to promote road engineering in its diverse aspects and to formulate methods and techniques for the optimum utilization of available constructional materials through research Facilities will be available for the investigation of problems on road materials, soil mechanics, rural roads, road-building machinery, incidence of accidents and road safety devices, and road statistics Provision has been made for collaborative research with engineering colleges and research organizations for the dissemination of results of research, and for the training of research and technical personnel.

The work of the Institute will be carried out in the following 6 divisions (1) Soils, (2) Bituminous, (3) Concrete, (4) Structural, (5) Roads, and (6) Economic and Statistical Research A Traffic and Operations Research Division will be added at a later date

The Institute is located in Delhi about a mile beyond Okhla on the Delhi-Mathura Road, and covers an area of 31 acres The buildings and equipment are estimated to cost about Rs 18,00,000, and the annual recurring cost is estimated to be about Rs 5,00,000

The staff of the Institute will consist of a Director, 6 heads of divisions and about 50 other research workers Dr Ernst Zipkes, an eminent road engineer from Switzerland, has been appointed Director of the Institute

The Institute will start functioning immediately in a temporary prefabricated building The work of 2 divisions, viz Soils and Bituminous, will be taken up in the first stage Necessary staff is being recruited and some equipment has been obtained from the Roads Organization of the Ministry of Transport

Investigations on vitrification of bricks in roadside kilns has been taken in hand. This work forms a part of the problem of developing road materials for deltaic regions

REVIEWS

Cybernetics : CONTROL AND COMMUNICATION IN THE ANIMAL AND THE MACHINE, by Prof Norbert Weiner (John Wiley & Sons Inc , New York), 1948, pp 194 Price $ 3

A BASIC SHIFT SEEMS TO BE OCCURRING IN industry — something equivalent to the revolutionary changes that followed the introduction of power machinery two centuries ago

People who keep a watchful eye on the field of technology can see the signs of this industrial revolution The rate of technical change is increasing every day These changes include the improvement of old processes and in many instances the changes themselves are fundamental The introduction of novel machines like reaction engines, materials like synthetics are a few new examples

What is the key idea of this second industrial revolution ? It may be the new emphasis on speed and lightness instead of strength and power Or may be the familiar easy source of raw materials or energy are nearing their end — driving us into new techniques Or may be for the war emergency new techniques are to be examined

Cybernetics is the title of a book written by Prof Norbert Weiner dealing with this phase of industrial revolution and the philosophy behind it

The sub-title of this book, "Control and Communication in the Animal and the Machine ", while evidently destined to contribute to the future progress of natural philosophy, is as yet too restrictively recognized for its name to have found its way in the dictionaries,

" Cybernetics " is the name Weiner and his M I T and Harvard associates have assigned to a new science The name is derived from the Greek word for " steersman " The science arises from the study of a particular type of machine control, and it can be used to designate the whole expanse of control and communication theory pertinent to the description, analysis or construction of systems All these systems have some common function, i e mechanisms for the reception of messages or stimuli, means for communication of these to a central control unit that responds through the system and instructions from the central control unit that produces definite action

The impact of war, with its urgent demand for gunnery prediction and other application of servo-control apparatus, was the deciding factor in directing Prof Weiner's attention to the essential characteristics of control in the truest sense of the term

The central concept in cybernetics is a " feed back " mechanism that, in response to information (stimuli, messages, impulses) received through the system, feeds back to the system definite instructions that modify or otherwise alter the performance of the system according to the necessity It is important in cybernetics to distinguish positive feed back which serves to increase what the system is doing in magnitude or direction from negative feed back, which serves to oppose the performance of the system, e g to reduce its magnitude or change its direction

Although feed back (and the control over a mechanism thereby effected) constitutes the central theme of cybernetics, there can be no feed back and no control unless there is communication of the incoming message (stimuli) from the receptor to the feed-back mechanism and transmission of its message (instructions) to the effector parts of the system (valves of a machine, or the muscles of a man) The theory and techniques of communication are, therefore, fundamental parts of cybernetics It will need the help of advanced mathematics like group theory and statistical mechanics Since communication of a message may be represented quite generally as a time series of impulses, this brings in the study of time series, and especially the statistics of time series The theory of wave filters and other devices used in telephone, radio and television circuits for unscrambling messages from mixed series falls within the province of cybernetics

Prof Weiner's book discusses all these ideas and their outstanding implications, illustrating them with examples drawn from a wide range of facts and theories from many sciences where statistical theories operate Throughout the book the author tries to show the dominance of statistical mechanics in modern physics and its vital significance for the interpretation of the nature of time The whole field comparing Newtonian and Bergsonian time has also been surveyed

Prof Weiner is to be congratulated in introducing a system of ideas of which no equally orderly presentation has hitherto been available to scientists He is, therefore, justified in writing a book with a mysterious title to attract wide attention to a new concept in science in general and its exemplification in the special field of control mechanics

The book evidently enjoys a wide circulation as the first edition was sold out in six weeks of its publication and is being reprinted for the fourth time Though the book is full of advanced mathematics which may prove difficult for the average physicist or engineer to follow, it is nevertheless a valuable and thought-provoking treatise

AJIT GUIN

Dynamic Equipment Policy, by George Terborgh (McGraw-Hill Book Co Inc, New York), 1949, pp xxiv + 290 Price $ 3 75

THIS IS A SOMEWHAT UNUSUAL TYPE OF BOOK for review in this *Journal* in the sense that its slant on scientific and industrial problems and methods is only indirect Nevertheless, it is to be recognized that the rapid improvements now taking place in scientific technology will fail in their ultimate purpose if, through the absence of well-timed replacement programmes (what the author calls "dynamic equipment policy") of capital goods and machinery, they fail to find suitable field application Moreover, a dynamic equipment policy means a dynamic economy This in turn means a rapid increase in the standard of living and in national well-being Not merely these In the international field where fears of aggression are not completely vanished, it means power, strength and security

In brief, the book deals with the financial and accounting means of "replacing" machinery employed in production The general thesis is that the usual text-book conception of providing for depreciation of an existing machinery is inadequate or inappropriate in an age of heightened tempo of scientific and technical progress, where capital goods are pushed out of service — *dis*placed rather than merely *re*placed — after they expire from physical decay Thus the book develops a concept of functional degradation of capital equipment with age and use, and its functional *dis*placement by superior alternatives These processes are well supported by algebraic reasoning and are illustrated by statistical examples, both actual and hypothetical

The following brief account of how Governments in the United States, United Kingdom and France reacted, should serve to show what importance these Governments attach to this problem It need hardly be emphasized that for under-developed countries, the problem is of even greater importance and urgency

The U S President's Scientific Research Board, while drawing attention to the fact that devastated Europe in rebuilding her factories will employ highly efficient industrial plant and equipment made possible by the most recent developments in technology, emphasized that "these (European countries) will soon possess industrial plants more modern than ours (American) of today"

"Since the turn of the century, the British have been paying, in terms of technological obsolescence, the penalty for their early industrial leadership Particularly in the basic industries, British facilities and technology were older and less efficient than their German counterparts   Today, one of the most serious long-term problems facing the British Government is the modernization of industrial facilities" In 1945 Sir Stafford Cripps, then President of the Board of Trade, set up "task forces" to make a technical survey of facilities, organization and operating practices in covered industries and to recommend programmes of reorganization and plant modernization In effect, private business was put on notice that it would have to achieve efficiency on its own initiative, or else .

A somewhat similar programme was launched in France in the same year by the Chairman of the National Commission for Industrial Modernization

At first sight this may appear to be merely the problem of the individual firm, but we must remember that the major beneficiary from an improvement is the customers and the consumers, and thus the problem is ultimately of national concern and governments have revised their fiscal and tax policies to serve these ends too

It is hoped that even without going into all the details of formulae, methods and illustrations — and the latter covers a very wide range of machines, from farm implements to textile machinery, from tractors to locomotives and from furnaces to metal working equipment — it has been shown how vital a correct appreciation of this problem is to industry

The book is a project work of the Machinery and Allied Products Institute of America, a federation of trade associations in the industrial equipment field in that country The author seems to have received very great help from such bodies as American Telephone & Telegraph Co, Iowa State College, Stanford University, etc, and with exceptional ability and remarkable lucidity he has done some intellectual pioneering and restated the fundamentals underlying the theory of equipment policy in a world of rapid technological changes

K B MADHAVA

Physical Aspects of Colour, An Introduction to the Scientific Study of Colour Stimuli and Colour Sensations, by Dr P J Bouma (N V Philips Gloeilampenfabrieken (Philips Industries), Eindhoven), 1949, pp 312 Price 30*s*

THE SUBJECT OF COLOUR IS OF GREAT importance from the point of view of both pure and applied sciences The sensation of colour is a complex problem involving as it does the physico-chemical aspects of colour production, physiological aspects of perception and psychological aspects of appreciation Though the scientific study of the subject has attracted the attention of the foremost thinkers and men of science — Leonardo da Vinci, Newton, Goethe, Schropenhauer, Thomas Young, Dalton, Maxwell, Rayleigh and Schrodinger — the progress of the subject has been slow and halting In recent years a new interest has been created in colour science by the rapid development of discharge lamps for artificial lighting and considerable progress has been made in our knowledge in the physical aspects of colour The results of these investigations are scattered in several original publications and are not readily available for many workers in the field The book of Dr Bouma fills up a keenly felt void and provides for the physicist and the illumination engineer a well got-up volume containing the fundamentals of the subject in all its essential aspects

The book consists of fifteen chapters The first chapter formulates the fundamental law of colour theories, namely that "by mixing *three* selected spectral colours in definite proportions any given colour sensation can be matched" After indicating the distinction between subjective brightness and objective brightness, the definition of brightness and other photometric quantities is given on the basis of international luminosity curves This is followed by an account of the colour triangle in terms of three selected spectral primaries, red, green, and blue, and the colour space These geometrical representations of colour, however, suffer from two chief defects, namely (1) negative co-ordinates for several colours and (2) the unfavourable location of the white colour These disadvantages are sought to be avoided in the rectangular or XYZ co-ordinate system based on three non-spectral primaries — a system adopted internationally since 1931 Chapter V gives an excellent account of this system In this, three co-ordinates which are three trichromatic coefficients, define a colour point, and a given chromaticity is represented by a straight line passing through the origin If we alter the brightness of a colour only, the colour point moves along the straight line The law of mixtures of two colours follows the law of vector algebra Thus if two colours have X-components, X_1 and X_2, the X-component of the mixture is $X_1 + X_2$, similarly for the Y and Z components Numerous examples of colour calculations in the XYZ system are worked out in chapter VI These examples illustrate how the colour co-ordinates of a light source can be determined when the components are given and include the light of the mercury arc, the white light and the light reflected by coloured surfaces

The remaining chapters deal with the applications of colour theories. Chapter VII deals with a few special light sources, colours of pigments and boundary colours and the theory of ideal and optimal colours and its application to reflection and transmission by coloured bodies and to colour filters Chapter VIII describes the methods used in objective colorimetry — spectro-photometer and photo-electric photometer, and chapter IX gives the methods of subjective colorimetry in relation to XYZ co-ordinate system The next chapter is solely devoted to a general survey of the defects in colour vision — their cause, nature and detection Chapter XI gives a historical development of colour science Chapter XII and XIII deal with the part played by human eye in such problems as discrimination and chromatic adaptation The concluding chapter gives a brief general survey of the problems of illumination engineering and practical applications of colour science in trade and industry

The book is profusely illustrated and contains numerous worked problems and tables of colour data which are of immense value to the specialist The author has eminently succeeded in giving the essential principles and the main developments in the subject in a simple and clear style and in a truly scientific manner A perusal of the book will no doubt be of great interest to the colour specialist and be instructive to every scientist

C S V

A Class Book of Physical Chemistry, by (Late) T M Lowry, F R S & S Sugden, F R S (Macmillan & Co, London), 1949, 2nd Ed, pp 454 Price 8/6s net

FIRST PUBLISHED IN 1929, THIS BOOK HAS been a great favourite of the student world Unlike some of the American books on the subject which are too mathematical and terse in their treatment or some Indian books which tend to avoid mathematics and be descriptive, the book under review makes a judicious use of the methods of the calculus What makes the book particularly useful is that it can also serve as a manual of practical physical chemistry At the beginning of each chapter, a number of experiments, illustrative of the principles developed later in the chapter are described in adequate detail This serves to bring out the practical aspect of the subject which is generally lost sight of by students beginning a study of physical chemistry

While including all the topics that go to constitute the normal scope of an elementary course of physical chemistry, the authors have devoted two chapters to "Phase Rule" This is likely to be of great help particularly to students of geology, glass, mining and metallurgy, etc The chapters on "Electrolysis and Electrolytic Dissociation" and "Applications to Electrolytes of the Law of Mass Action" are particularly comprehensive for a book of its standard and the present edition contains sections on activity coefficients, proton concept of acids and bases, colloidal electrolytes, etc The chapter on "Thermochemistry and Thermodynamics" includes two sections on the first and second laws of thermodynamics and some of their applications These are the most welcome features of the book The reviewer is aware of no other book of similar scope which presents the above-mentioned topics in such simple and readable form The time is past when it could be considered that these topics constitute advanced portions and may be omitted from a first course in physical chemistry

The omission of topics like atomic structure, valency and radioactivity is to be regretted It is true that these may be taught as part of general chemistry but they really constitute an integral part of physical chemistry and their inclusion will enhance markedly the utility of the book

The printing error on page 233 where RT^2 is printed as TR^2 requires correction

K S V.

A Chemistry of Plastics & High Polymers, by P D Ritchie (Cleaver-Hume Press Ltd, London, Interscience Publ Inc, New York), 1949, pp viii + 288 Price 25s **High Polymeric Chemistry,** by W S Penn (Chapman & Hall Ltd, London), 1949, pp xiv + 487 Price 36s

ONE OF THE DIFFICULTIES STANDING IN THE way of high polymer chemistry finding general acceptance in the regular university chemistry syllabus is the dearth of suitable text-books The excellent literature available is in the form of either specialized monographs such as those of Interscience's High Polymer Series, or technical publications, rather limited in scope, such as Carlon

Ellis's *The Chemistry of Synthetic Resins*, Morrell's *Synthetic Resins & Allied Plastics*, etc The two books under review have been written expressly to meet the academic teaching requirements in this field in its broad outlines

Dr Ritchie's book, based on the series of post-graduate lectures delivered by him at Birmingham Technical College and Leeds College of Technology, has been written primarily for under- and post-graduate students with a fair mastery of organic chemistry with a view " to show the astonishing breadth of the field , to illustrate natural and synthetic, usual and unusual, highly complex and relatively simple polymers , to concentrate upon organic without wholly neglecting inorganic substances , to summarize raw material sources and current synthetic methods , and to survey recent advances without having to omit introductory and fundamental principles completely " (Preface) He has successfully realized these aims in his well-planned and well-composed book, consisting of sixteen chapters and author and subject indexes

The very brief I and XVI chapters explain the need, on the one hand, to retain the term " plastics ", because of its general acceptance and the great variety of industrially important materials it stands for, and, on the other, to employ systematically the term " high polymers " in view of its scientific accuracy and comprehensive character to include not only plastics but fibres and rubbers, both natural and synthetic Chapters II, III and XV deal with the broad physico-chemical topics, " Polyfunctional Molecules and Polymerization ", " Mechanism and Kinetics of Polymerization " and " The Relation between Structure and Physical Properties in High Polymers ", explaining the fundamental principles involved adequately enough to enable one to pursue the subject in advanced, specialized monographs Synthetic addition polymers are treated in chapter IV and condensation polymers in chapters V to VII Chapter VIII is a short introduction to natural high polymers which are classified into the protein (IX), cellulose (X), lignin (XI) and rubber (XII) groups Chapter XIII is devoted to drying oils and XIV to inorganic and mineral high polymers which comprise not only silicates, silicons, glasses, felspars, ultramarines and zeolites, but also polymers of sulphur, selenium in general of the elements of IV to VII groups of the periodic table In the earlier chapters too, are included simpler polymers and polymers of little industrial value, on account of their structural and other theoretical significance

In view of academic teaching requirements, considerable attention is given to synthetic and structural aspects of raw materials and polymers, as is evident from the hundreds of structural formulae throughout the book and from the critical account of possible reaction mechanisms The only criticism which can be made is that, although general bibliography for further reading is appended to each chapter, one does feel annoyed a bit at the absence of exact literature references to authors quoted in the text with date (year), particularly in the case of less well-known investigators A few typographical mistakes have been noticed such as Heilbronn with double n, and VII instead of VIII at the head of the chapter in question

Dr Ritchie's is a book of " considerable distinction " Felicity of expression and elegance of style make it very readable Conciseness and cogency of development of the subject have enabled the author to pack a good deal of information in a modest and moderately priced volume As an excellent introduction to a serious study of high polymer chemistry, it will be welcomed both by teachers and students as well as research chemists who wish to familiarize themselves with this new subject of growing importance

Mr Penn's *High Polymeric Chemistry* hardly comes up to his expectation of its being accepted as " a standard text-book " (Preface) It does contain within its sixteen chapters and an appendix a large amount of information, larger than the previous book, but presented in a very unsatisfactory manner

Wishing to bring out the difference between what he calls " a perfect molecule " and one obtained by polymerization of a diene, the author says, " This, at this point, is worth discussing a little further, as here we have in practice, the difference between a perfect molecule (the rubber), and a molecule formed in the laboratory or on a commercial scale Somehow or other, nature manages to bring carbon and hydrogen together in such a way as to avoid the complications which arise during polymerization It is not possible to discuss and describe these complications at this point, but some of the departures from the perfect molecule can be illustrated " (pp 5 and 6) This is immediately followed by the sub-section (1 2 2) entitled " Inadequacy of Present Instruments ", apparently unconnected with the previous topic, which starts off with the statement, " Many methods have been tried to give quantitative expression to the plasticity of high polymers Most of them, however, have many defects and more qualitative in nature " (p 6) Only after several sentences are we told of the heterogeneity of synthetic polymers as compared with natural rubber

Again under the sub-section " Analytical Schemes " (3 9), the author points out that " One of the outstanding needs of chemists engaged on synthetic resin production is a good analytical scheme " A few lines later, as if to surprise the reader, he says, " It is no exaggeration to say that the structure of many polymers is unknown Even a relatively simple molecule, like polyvinyl chloride, has the old head-head or head-tail problem " (p 95), knowing full well Marvel's conclusive work on this point Conscious of this misplaced remark, he corrects himself " This immediate section, however, concerns the recognition of an unknown resin Methods of ascertaining the internal structure of molecules will be described under individual polymers It is not the object of this book to present a complete scheme which will answer all problems, but, by following the procedure outlined below, it should be possible to ascertain exactly what any high polymeric molecule is " (pp 95 and 96) In the remaining one page or so, except for a few general references not much is given of the promised analytical procedure These two passages have been quoted at some length in order to illustrate the author's treatment of any topic in question and his general style of writing Inaccurate statements (cf also high pressure and temperature being classified as catalysts along with various chemicals, p 45), pointless generalizations, useless repetitions, disparaging remarks and rambling style do not make for clear and cogent presentation of the subject-matter or for economy of space

In spite of the author's reassurance, there is nothing " new " in the division of polymers into chapters which cover about the same materials as the previous book A special chapter (15) on " Preparation of Monomers " gives some details for a few of them and for the rest indicates general procedures with literature references " Looking to the Future " (chap 16) sounds promising but is actually disappointing with regard to forecast of possible trends in various polymers from industrial or research viewpoints Appendix on " Low Temperature Polymerization " is a late addition incorporating recent work on the subject The chapters on general and physico-chemical topics (1, 2 and 9) make particularly difficult reading One redeeming feature of the book is the fairly exhaustive list of references to scientific and patent literature at the end of each chapter But their numbering follows neither alphabetical order of authors' names nor the sequence of their appearance in the text , the higher number references seem to be a later addition, appearing as they do in the earlier sections of a chapter Several typographical mistakes have been detected The printing is good and several photographs have been included in the text, illustrating instruments, X-ray diagrams and plastic materials

It is a pity to have to say that on the whole the book is badly written and it is doubtful if it would be " of great assistance to industrial and university students " or to " research workers as a reference book for methods and theories " except possibly " as a guide to the whereabouts of further literature on the subject " (Preface)

L M YEDDANAPALLI

Industrial High Frequency Electric Power, by E May (Chapman & Hall Ltd , London), 1949, pp 355 + 208 diagrams Price 32*s*

THE BOOK DEALS WITH THE THEORY AND practice of radio frequency heating and is intended to meet the needs of engineers engaged in the field of industrial H F technology

The book begins with a summary of basic circuit theory This includes a brief treatment of transformers as used in R F heating practice In the next two chapters, the arc and spark oscillators and H F alternators, both wound rotor and inductor types, are described showing the constructional details in many cases Considerable space has been devoted to the explanation of class B and class C operation of valves used as R F generators Typical design problems with high power valves have been worked out Valve generator equipment for induction heating have also been briefly described

The sixth chapter entitled " Induction Heating " opens with discussions on H F magnetic flux and current distributions in a cylindrical charge, power developed in several types of charges, work coil and the solution of its associated problems Having thus laid the foundation, the author goes on to describe induction melting furnace, surface hardening, hardening of inside surfaces of cylindrical work, through heating, etc The subject is discussed very fully with numerous diagrams and examples

The mechanism of dielectric heating is explained in terms of a lossy condenser Power oscillators required for the purposes of dielectric heating are briefly described The coupling of the load to the oscillator tank coil and matching by transmission lines are discussed

One chapter is devoted to the description of the auxiliary equipment and the routine measurements necessary in an R F heating laboratory The last chapter deals with the industrial applications of H F and operating problems

Practical data have been supplied freely throughout the book and a good selection of references to journals has been added at the end

The book is a very useful publication and can be unhesitatingly recommended to those engaged in industrial high frequency applications

G SANYAL

Modern Synthetic Rubbers, Harry Barron (Chapman & Hall Ltd , London), 1949, pp xix + 636 Price 45*s*

THIS IS ONE OF THE FEW BOOKS IN ENGLISH language on " synthetic rubbers ", and since its first appearance in 1942, it has run into three editions The subject-matter has been divided into 22 chapters covering the economics of synthetic elastic materials and their chemistry and technology In addition to synthetic vulcanizable materials, discussions on non-vulcanizable materials are also included A chapter has been added in the end on the comparative properties of elastomeric materials in general

An ardent advocate of synthetic rubber programme, Dr Barron has done very well in bringing together valuable material which has been hitherto scattered in the *BIOS* and *CIOS* reports and other technical literature However, in his enthusiasm he has included in this book material which might as well have been abridged and thus some of the space released devoted to the presentation of matter of theoretical importance to the problem of synthetic rubbers One finds a considerable amount of repetition, for example, "Acetylene Buna Synthetic Rubbers" (pp 119 and 122) and paragraphs I and II on page 432, etc The subjects of crystallization and of structure of rubber by X-ray methods have been disposed off in a very brief manner and there is no reference to the work of Wood and Bekkedahl or of Bunn and Gehman The mechanism of polymerization (p 198) is also inadequately discussed

On going through the book, several discrepancies and errors are noticeable Through all the successive editions of the book, rubber has been described as having a " *trans* " structure and gutta-percha a " *cis* " configuration (p 93) There is an overwhelming evidence to the contrary and it is accepted today that rubber possesses a " *cis* " configuration and gutta-percha the " *trans* " one

While discussing the technique of polymerization for the preparations of synthetic rubbers, it has been mentioned that the modern practice favours " copolymerization of a diolefine with a synthetic resin " (p 201) The correct statement should be " copolymerization of a diolefine with vinyl type of monomers " The latter, as is evident, are characterized by a terminal double bond

While discussing the case of butyl rubber, the rôle of diolefine unit which is responsible for its vulcanizable character has not been properly appreciated It is precisely due to the low percentage of the diolefine in the butyl chain that there is a need for what is technically called a " tight cure " — a fact which should have been mentioned (p 211 and chapter 18)

In the last paragraph (p. 212) reference is made to the diagram illustrating the chemical structure of GR-S, rubber and gutta-percha hydrocarbons In so far as one can see, the diagram gives the structure of GR-S only

While discussing the neoprene lattices (p 231), the author has not mentioned the prevalent method, viz " freezing ", followed for the preparation of commercial neoprene

Comparison is made of the properties of natural rubber and GR-S (p 239) It is necessary, however, to qualify the nature of stock used for the data presented

In compiling the types of accelerators (p 272), the author has omitted to mention the important class of accelerators known as guanidines and aldehyde amines The author's own structural formula for DPG (p 278) has persisted through his books on rubber

The author has mentioned (pp 299 and 349) that there is a considerable variation in GR-S which is being manufactured in various factories in U S A His attention may perhaps be drawn to the very commendable work that has been sponsored by *Rubber Reserve Co* of U S Government at the Synthetic Evaluation Laboratory, Akron National Bureau of Standards, Washington and other laboratories which has resulted in the narrowing down of the variations from standard specifications and has led to the manufacture of rubber of a more uniform quality Meuser, Stiehler and Hackett, in a paper presented at the " Symposium on Rubber Testing " held under the auspices of the " American Society for Testing Materials ", have given a summary of testing and inspection procedures in Government synthetic rubber plants by the adoption of which the variability of the product in each plant or from plant to plant has become decidedly smaller in the last few years

The use of the term ' crack point " (p 483 *et seq*) is perhaps a little unfortunate What it probably implied is the " brittle point ", a term which is accepted in technical literature

In going through this book, one is led to the conclusion that several paragraphs have been placed out of context In discussing alcohol and acetylene as raw materials for the manufacture of butadiene, mention of the condensation elastomers of the type of Norepol and Agripol (p 106) is a little out of place and so is the description of the Russian alcohol process (p 186)

There are a few misprints that completely alter the sense of the statements made Ethylene is described as being prepared by dehydrogenating acetylene (p 159) Films of GR-S type I late are reported to give ' slow tensile " (p 361) Probably the correct statement should have been ' hydrogenation of acetylene " in the first case and " low tensile in the second

Synthetic rubbers both replacement and speciality type, have come to stay and the " know-how ' of their manufacture has placed in the hands of the technically advanced countries an asset whose value is inestimable, except during the periods of stress The author has done a signal service in bringing together a great deal of material not otherwise easily available

M R VERMA

NOTES & NEWS

Berkelium

DISCOVERY OF A NEW ELEMENT, No 97, named berkelium (after Berkley, the city in which it was discovered), the heaviest so far, is reported as a result of researches conducted at the University of California Radiation Laboratory (*Sci Newsletter*, 1950, **57, 51**)

The 241 isotope of americium was irradiated with helium ions resulting in the production of an isotope of the element 97 which is 244 or 243 in atomic weight The new element was separated by a combination of precipitation and ion exchange absorption methods making use of anticipated properties including oxidation states and its position in the periodic table as a member of the actinide transition series Berkelium has distinctive chemical properties and is short lived, decaying by electron capture in a 4 5 hr half-life These constitute the primary evidence for the creation of a new element

A New Amino Acid

A NEW AMINO ACID THE α-Σ diaminopimelic acid occurring in the acid hydrolysate of the water-insoluble portion of *C diphtherias*, has been isolated employing a phenol-collodine paper chromatogram (*Nature*, 1950, **165, 74**)

Neutralized hydrolysate was run through a column of acid-treated alumina, the unknown amino acid, although neutral, is retained on the column with the acidic amino acids if a sufficient excess of alumina was used Elution with dilute ammonia was followed by electrodialysis of the concentrated eluate The neutral fraction, completely freed from acidic constituents, yielded on concentration a white crystalline material which proved to be the unknown amino acid

The final product after crystallization, twice from water and once from aqueous alcohol, gave the following analytical figures C, 44 3, H, 7 45, N, 14 8, α-amino N (Van Slyke ninhydrin CO_2), 14·4, diaminopimelic acid, $C_7H_{14}N_2O_4$, requires C, 44·2, H, 7 42, N, 14 8 per cent The crystals were only moderately soluble in cold water and aqueous alcohol, soluble in dilute acids and alkalies and insoluble in all other solvents The substance did not melt or decompose up to 305°C and was indistinguishable from the acid obtained by hydrolysis of the synthetic dibenzoyl derivative

The new amino acid occurs mainly in the water insoluble portion of the diptheria bacillus, although a small amount is also found with the other commonly occurring amino acids in cell extracts

Electrical Resistance of Magnesium

MAGNESIUM EXHIBITS INCREASED electrical resistance at temperatures below 6° absolute or below −449°F The phenomenon promises new insight into the structure of matter (*Sci Newsletter* 1950, **57, 41**)

Continuous Superphosphate Process

A CONTINUOUS PROCESS AND UNIT for the manufacture of 20 tons of superphosphate per hour operated by the *Kuhlman Company* in France is described (*Chem Trade J* 1950 **126, 137**)

The acid and phosphate are automatically distributed and measured continuously by a volumetric feed and a constant weight feed respectively The two are mixed in a small sheet-iron vessel fitted with turbine pedals The slurry emulsified by the introduction of air is allowed to spread on to a conveyer belt in a thin layer to permit an intensified reaction and a rapid set At the end of the belt opposite the mixer, the superphosphate enters a disintegrating device consisting of steel wires tightly drawn between formers at each end of the shaft, the axis of the cylinder being at right angles to the line of movement of the belt The end of the belt near the disintegrator is under strong suction which dries and cools the superphosphate The material dropping from the disintegrator is conveyed to the storage shed by a rubber belt The accurate regulation of the raw materials, their effective mixing and aeration, the setting of the superphosphate in a thin layer in the absence of any pressure, intense evaporation of the moisture and finally, the division into fine particles, gives a superphosphate of excellent physical properties, light, sandy, dry, hardening very little during storage, very soluble and homogeneous

The wear and tear on the plant is very small and its simplicity and safety make it possible for a single workman to run and supervise the installation

Reagent Grade Chemicals

THE MANUFACTURE OF REAGENT grade chemicals at the New Jersey plant of *Eimer & Amend*, U S A, is described (*Chem Trade J* 1950, **126, 153**)

Three procedures are practised purification of the commercial grade compound, synthesis from high purity starting materials, and synthesis from commercial grade starting materials with subsequent purification The preparation of barium chloride to A C S specifications is cited as an example This consists of the purification of a commercial grade of the material by the removal of about 96 per cent of its calcium chloride and strontium chloride impurities A 1-ton working batch of the commercial material is divided into 10 aliquots which are placed in open-top rubber-lined steel containers of 15 gal capacity and made into a slurry Agitation is by a hand-manipulated rubber-coated steel paddle Each aliquot is centrifuged in rubber-lined basket centrifuges This washing operation removes approximately 90 per cent of the total strontium and calcium chloride present Only about 2 75 per cent of the barium chloride is lost

A secondary and final purification is effected by a recrystallization of the barium chloride from a saturated solution The damp crystals from the washing operation are removed with stainless steel hand scoops from the centrifuge basket A saturated solution is formed by consecutively dissolving these batches in 60-gal portions of distilled water in a 75-gal steam-jacketed kettle heated to 80°C, the contents being agitated by air

Iron impurities are precipitated by adjusting the pH of the solution to 9 ± 0·5 by the addition of approximately 0·25 lb of technical barium hydroxide to a batch of solution. Removal of the iron precipitate is effected by filtration through a neoprene-coated 12″ eight-chambered filter press. The filtrate is discharged into two glass-lined, steam-jacketed, steel evaporating pans, each of 60 gal capacity. The solution is evaporated to about 20 per cent of its original volume, and the purified crystals are removed by hand, centrifuged and dried in a steam-heated, mechanical-convection tray dryer.

Zirconium Compounds

THE PRODUCTION AND SOME OF the latest applications of zirconium compounds are described (*Chem Trade J* 1950, **126**, 169).

Zirconium sands consisting of a mixture of zircon, rutile, ilmenite and quartz are separated by hydraulic methods and then by electrostatic and electromagnetic separators to yield the zircon of commerce containing about 98-99·5 per cent of zirconium silicate. Higher grades are prepared by acid washing the mechanically purified product, followed by calcination. To prepare zirconium oxide and zirconium chemicals, the zircon is heated in an arc furnace with carbon. The silica content vaporizes and the zirconium combines with carbon. If an excess of carbon is used, the product is zirconium carbide, while if less amount is used, a product called "zirconium cyanonitride" is obtained. Both these compounds can be burned in air to form zirconium oxide, or burned in chlorine to form zirconium tetrachloride. When zirconium tetrachloride is added to water, it decomposes and forms the soluble salt, zirconium oxychloride. The salt is of industrial importance in itself and is an intermediate in the preparation of other useful compounds such as the hydrous oxide, acetates, sulphates and nitrates.

The ceramic uses of zircon and zirconia arise from its high reflectivity of light, high melting point and thermal stability, chemical inertness (particularly of zircon) and high specific gravity. Some of the more important applications are melting aluminium, production of metaphosphates, smelting of glass and of raw mixtures for enamel and glaze frits, ramming mixtures in induction furnaces and furnace blocks. In the melting of aluminium, the resistance of the zircon to being wetted by the molten aluminium is the primary advantage. The chemical inertness of zircon enables its use in the construction of equipment when extreme resistance to chemical action is required, e.g. in the construction of rotary kilns. Now refractories thermal shock stability has been achieved for zirconia by the addition of small quantities of lime and magnesia.

The largest use for soluble zirconium compounds is in rendering textiles water repellent. This use depends on the affinity of zirconium for textile fibres and its property of forming hydrophobic (water repellent) soaps with fatty acids. Mildly acidic and alkaline salts such as zirconial acetate and ammonium zirconyl carbonate have been introduced for the purpose.

Zirconium is a precipitant for acid dyestuffs and, when properly controlled, coloured pigments of excellent general properties and outstanding tinctorial strength are obtained. These pigments are particularly suitable for printing inks, where their high strength permits more brilliant colour effects than those previously obtainable with similar shades of lake pigments. The ability of certain zirconium salts to precipitate acid dyes has also improved the lake pigments. Zirconium has also found use in the preparation of pigments from basic dyes. When a basic dye solution such as methyl violet is added to a slurry of the electronegative zirconium oxide, an intensely coloured solid forms, which on filtration, washing and drying produces a strong, soft pigment.

Zirconium salts also tan leather. The sulphate has been found most satisfactory and leathers prepared with this agent were of good strength, withstood exposure to light and hot water, and were stable.

Other present or prospective uses of zirconium chemicals are in the mordanting of textiles, incandescent gas mantles, catalysing organic synthesis and hydrocarbon cracking. Zirconium compounds show promise as radio-opaque materials for use in X-ray and fluorescent diagnosis, while some of the salts have been found useful in the treatment of certain skin troubles.

Wax Casting

THE METHOD COMPRISES IN THE production (via a master pattern in wood or metal and a soft die) of a positive replica in wax of the desired moulding. The method is being increasingly used in the production of gas turbine blades and other precision castings for which it offers the advantages of producing castings of such good surface, finish and accuracy that subsequent machining is unnecessary. Further it enables the production of shapes too complicated or irregular for ordinary moulding methods.

The wax replica is invested in a refractory mould. The wax is melted away and the mould is then baked. The metal component is next cast. Refractories bonded by ethyl silicate have been found most suitable for the investing mould. By lowering the amount of the scrap produced and cutting down the sequence of operations, the method is expected to prove to be sufficiently economical to permit wide application in general foundry practice (*Chem Trade J*, 1950, **126**, 135).

Hemicellulose Acetate Films

THE FILM-FORMING CHARACTERistics of hemicelluloses are reported (*Science*, 1949, **110**, 713).

The corncob is a typical example of hemicellulose-rich material. Approximately 80 per cent of it consists of polysaccharides, one-half of which is cellulose, and the remainder is a mixture of hemicelluloses. The holocellulose can be prepared by a modification of the usual sodium chlorite procedure. Practically all of the hemicelluloses may be removed from holocellulose by extraction with a 10 per cent solution of NaOH. The residue is almost pure α-cellulose. Neutralization of the alkaline hemicellulose solution causes precipitation of the higher molecular weight polysaccharides and leaves in solution most of the glycuronans and polysaccharides of comparatively low molecular weight. The precipitated material is hemicellulose A. Most of the soluble material remaining in the neutral solution is precipitated by the addition of two volumes of alcohol and is hemicellulose B Hemicellulose A can be esterified with acetic anhydride in the presence of 0 25 per cent of nitric acid to produce a white fibrous acetate containing 38 6 per cent of acetyl groups (calculated for diacetyl xylan, 39·8 per cent) The acetate is soluble in dioxane, pyridine, or in a chloroform-methanol 9 1 mixture When the acetate is cast from any of these solvents, clear films are produced which show an average tensile strength of 7 2 kg/mm^2 Films from commercial cellulose triacetate, when prepared in a similar manner, have a tensile strength of 8 6 kg/sq mm Films cast from solutions of mixtures of hemicellulose A acetate and cellulose triacetate are clear and strong provided the hemicellulose A acetate content does not exceed 50 per cent Larger amounts of hemicellulose A acetate produce cloudy films

Hemicellulose B, 6 per cent of which is glycuronan material, may be esterified easily by a mixture of acetic anhydride and pyridine, provided that it is first swelled in formamide The resulting acetate is a light-brown material and when cast from a chloroform solution it produces clear films having a tensile strength of 7 5 kg/sq mm

Nicotine Variation in Tobacco

ANALYTICAL RESULTS OBTAINED over a number of years on shed-cured tobacco have shown marked variation in the nicotine and other alkaloids content (*Science*, 1949, **110**, 715) Normally over 90 per cent of the tobaccos do not vary more than about ± 10 per cent from the average for the year The variations represent differences from field to field, depending upon the soil, fertilizer, seed, and variations in rainfall occurring between the time of early and late harvesting of crops by different farmers There is no relation between *p*H and alkaloid content. Plotting the average alkaloid content for the various years against the amount of rainfall during the growing season shows a definite trend of higher alkaloid content in tobaccos grown in dry seasons By breaking this down into months, it is found that the influence of rainfall on the alkaloid content is somewhat greater towards the end of the growing season as the time of harvest approaches Individual crops have been followed through complete manufacturing operations, including fermentation The average amount of alkaloid reduction is about 40 per cent, all based on over-dried samples

A Micromethod for Fat Analysis

A PHYSICAL METHOD FOR THE estimation of fatty acids has been developed at the *North Western University Medical School*, Chicago (*Science*, 1950, **3**, 9) The method is based on the property of water-soluble fatty acids to spread in mono-molecular layers with each molecule occupying an area of 20 5Å independent of the number of carbon atoms in the molecule The spread of the film is little affected by temperatures from 20° to 30°C if a film tension of 20 dynes per sq cm is maintained It is relatively simple to estimate fatty acids with greater sensitivity and accuracy by this technique

A circular glass dish supported on a levelling table in an enamel tray is coated with hard paraffin and filled with 0 3 per cent H_2SO_4 (*p*H 1-2) until the level is above the edge of the dish Droplets of piston oil are placed on the surface of the solution after cleaning the surface with a glass slide Oil is added until the colour is green Such a film has been shown to have a uniform tension of 20 ± 2 dynes/sq cm Piston oil is a good grade of lubricating oil heated to 300°C for 8 hr The fat to be estimated is extracted in a clear petroleum ether solution in a volumetric flask from which a definite aliquot is placed by means of a capillary pipette in the centre of the piston oil film As the solvent evaporates, the liberated fat spreads as a film against the pressure of the heavy oil film until equilibrium is reached

A glass pane is placed on the enamelled tray, clearing the water surface by approximately ¼ in A timer is started as soon as the fat solution is added The film is allowed to age for 3 min, at the end of which, by means of a wax pencil, the boundary of the film between the fat and the piston oil is traced on the glass surface The outline on the glass plate is readily traced on co-ordinate paper and the area is obtained by counting the squares, or if plain paper is used, the outline is traced with a planimeter

Scintillation Counter

A NEW INSTRUMENT TO REPLACE the Geiger counter has been developed at the RCA Laboratories The instrument consists essentially of a multiplier photo tube of which the latest is RCA 5819, and a fluorescent screen or phosphor crystal The multiplier tube is worked by "secondary emission" and contains a photo cathode and a series of 10 dynodes or amplifying stages The flash of light, caused by a radioactive particle striking the fluorescent screen, falls upon the photo cathode of the tube, releasing a number of electrons These electrons are directed or focussed electrically to the first of the amplifying stages where each electron knocks off a new shower of electrons Each of these new electrons in turn is swept to the second dynode and again each knocks off a shower of electrons This process is repeated at successive dynode stages, until at the last stage innumerable electrons are emitted representing a multiplication of as much as one million times the number of initial electrons released by the original light flash entering the tube The electrons are collected at the last electrode to become the electrical current put out by the tubes

In addition to the increased counting rate and enormous amplification provided by the counter, the instrument is capable of detecting with suitable phosphors all atomic radiations known so far, including α-particles, soft β-rays and X-rays It is capable of discriminating or counting radioactive particles arriving less than 100-millionth of a second apart The detection of these soft radiations with Geiger counters requires thin, hard-to-make "windows" to minimize the absorption of the soft radiations by the envelope of the detector tube The scintillation counter is rugged and stable, and has high intrinsic efficiency and long life

A Mathematical Theory of Shaded-pole Motors

SHADED-POLE MOTORS ARE PRACTICALLY without exception provided with pole wedges which complicate their theoretical analysis. A mathematical theory is enunciated to explain and analyse these characteristics (*Acta Polytechnica*, 1949, 48)

The analysis is confined to the fundamentals of the m m f curves The effects produced by the pole wedges on the characteristics of these motors are elucidated by numerical examples and test results The characteristic curves have been obtained for an experimental motor of typical design and the theoretical results are compared with those obtained from tests The influence of various motor constants on the characteristics of the motor has also been studied

G D JOGLEKAR

New Tensionmeter

DEVELOPMENT OF AN IMPROVED type of tensionmeter by *Saxl Instrument Co*, Massachusetts, is reported The instrument has twice the sensitivity of the old model, has a capacity of 125 gm, is equipped with quick trigger action and gives steady readings even on quickly traversing machinery This enables quick tension measurements to be taken on all yarns including nylon and rayon and on machines such as warpers, winders, slashers and for winding elastic threads, checking shuttle tensions, etc Roller friction is negligible as the meter is provided with ball bearings throughout A transparent flywheel through which the readings can be taken has also been introduced

High-grade Synthetic Mica

LARGE SHEETS OF SYNTHETIC mica have been obtained at the U S National Bureau of Standards by processing quartz, magnesite, bauxite and a fluro-silicate compound (as a crystallizing agent) at normal atmospheric pressures in plantinum-lined crucibles (*Sci Newsletter*, 1950, 57, 35)

The mixture is melted in an electric furnace at 2,550°F As the furnace cools, mica crystals grow from tiny seeds at the bottom of the crucible The synthetic mica is superior to the natural variety in resisting breakdown at high temperature

Chromium from Tannery Waste

PRELIMINARY EXPERIMENTS ON the possibility of reclaiming chromium waste from tanneries in Australia have shown that all the discarded chrome can be recovered by simple methods involving precipitation with lime, filtration and heating as the main operations The chrome may either be recuperated in the form of chromium oxide (for green paints) or recovered to a stage where liquor is obtained for re-use in tanneries (*Tech Newsletter*, 145, Australia)

Improved Rice Varieties

THE FOLLOWING RICE VARIETIES capable of increasing the yield from 16 to 32 per cent have been evolved as a result of investigations conducted in Travancore under the *ICAR* paddy research scheme *MO1* or *Chettivirippu*, has given an average increase of 30 per cent in field trials The duration of the crop is 90 days and the average yield is 1,800 lb per acre *MO2* derived from *Kallada samba* gives an increase of 22 per cent With a crop duration of 95 days, the average yield per acre is 2,000 lb, *Ptb* 10 average increase 20 per cent, yield under local conditions 1,800 lb As a result of these experiments a third rice crop is likely to be introduced during the year in areas where irrigation facilities exist thus increasing the crop yield by about 50 per cent over the present production

Utilization of Tree Barks

INVESTIGATIONS HAVE BEEN CONducted on the utilization of barks of trees which constitute 6 to 9 per cent of the weight of the logs, for producing hard boards at the *Forest Research Institute* Dehra Dun (I F Leaflet No 118) Barks of *shorearobusta* (*sal*) and eucalyptus spp were chemically analysed and the fibre obtained by beating the bark with a wooden mallet was subjected to a steaming treatment (40 lb/sq in for 2 hr) and then pressed under heat and pressure either with or without addition of resin or lignin waste liquor Powdered *sal* bark in admixture with saw-dust and resins was also employed The preliminary results indicate that it is possible to make boards of satisfactory strength from these tree barks The water resistance and other properties of the boards can be improved further

Potency of DDT

STUDIES CONDUCTED AT THE *Establishment Laboratory*, Kanpur, have shown that the addition of a small amount of β-methyl anthraquinone, the chemical found in Burma teak, makes DDT more powerful and its effect lasts much longer Glass plates treated with DDT were more potent killers when stored previous to use in a box of Burma teak The chemical alone however, does not affect the mosquitoes (*Sci Newsletter*, 1950, 57, 25)

Aluminium Welding

A NEW PROCESS, 4 TIMES FASTER than any previously known method for joining aluminium plates, ¼" to 3" or more in thickness, has been developed (*Chem Engng*, 1950 57, 150) The process, known as aircomatic, uses a pistol-shaped welding tool with bare or processed filler metal in wire form supplied at controllable rates of speed A sheath of argon or helium gas surrounds the arc, preventing air from coming in contact with the molten metal Since no solid fluxes are required, there is no slag to be cleaned from the joint

Abstracts from Japanese Scientific Journals

DURING THE PAST TWO YEARS abstracts have been prepared in English from Japanese scientific journals in the Scientific and Technical Division, Economic and Scientific Section, General Headquarters Supreme Commander for the Allied Powers, and a report listing the Japanese journals under publication the address of publishing agencies, the current appearance or non appearance of each journal, and the agencies outside Japan to which each series of abstracts has been forwarded, has been prepared Seventy four journals representing 15 scientific fields have been included in the programme Basic copies of all abstracts have been deposited with the *Office of the Technical Services, Department of Commerce*, Washington D C, where facilities are available for cataloguing, microfilming and photostating File copies of all abstracts are also on hand in the Scientific and Technical Division Journals containing articles published entirely or with résumés in non Japanese have not been included in the programme

The agencies receiving abstracts are Office of Technical Services Chief Library Division, Department of Commerce, Washington D C , *Chemical Abstracts*, Ohio State University Columbus 10, Ohio , *Biological Abstracts*, University of Pennsylvania, Phila 4, Pa , *Physical Sciences* American Institute of Physics 57 E 55th St., New York 22, N Y , *Metal Reviews*, 7301 Euclid Avenue, Cleveland, Ohio , and *Mathematical Reviews*, 531 West 116 St , New York 27, N Y

Fruit Preservation Centre

A FRUIT PRESERVATION CENTRE has been established in Bangalore by the Mysore Government A pilot plant costing Rs 20 000 has been installed at the centre to conduct experiments on keeping qualities of fruits particularly those peculiar to India such as jackfruit, wood apple, banana, oranges, etc , with a view to making them into jams and jellies The installation of a large-scale unit costing Rs 5 lakhs is contemplated after the preliminary investigations are completed

The Metal Market Review

THE SECOND ANNUAL NUMBER of the journal (February 1950, price Rs 5) contains useful review articles on technical and commercial aspects of metals and their alloys with particular reference to the position of Indian metal trade and industry Statistics on metal production, consumption, import and export and world metal prices from the year 1900 to date are also included A useful addition is a map of India indicating the location and other details of the proposed electro-metallurgical industries in India The volume is copiously illustrated and neatly got-up

Announcements

Institute of Population Statistics — An Institute of Population Statistics is being established under the auspices of the Annamalai University to study all aspects of Indian and Asiatic demographic problems and to co-ordinate the researches of social scientists Dr S P Chandrasekhar is the founder-director of the Institute

I W S Research Fellowship — The International Wool Secretariat has announced a research fellowship tenable by an Indian student to the value of £300 to £700 per annum for the encouragement of research in an approved subject concerning the wool industry Full particulars regarding the fellowship are available from the Manager International Wool Secretariat, Post Box No 451, New Delhi

International Tin Research & Development Council — Mr V A Lowinger has retired from the Chairmanship of the Council He is succeeded by Mr G F A Burgess, a Joint Managing Director of the British Metal Corporation Ltd

A S T M — The 53rd Annual Meeting of the American Society for Testing Materials will be held from June 26 to 30 at Atlantic City, N J

Grant to Banaras Hindu University — A grant of Rs 11 lakhs has been made by the Government of India to Banaras Hindu University The main items of the grant are Rs 3 5 lakhs for the Agricultural College, Rs 2 lakhs for scientific manpower to be utilized in the form of scholarships Rs 84 000 for the College of Technology, Rs 1,30,000 for the Engineering College and Rs 2 lakhs for development purposes

The Madras Institute of Technology has been given a non-recurring grant of five lakhs of rupees towards the cost of equipment by the Madras Government

Major-General Dr Sahib Singh Sokhey, until recently Director, Haffkine Institute, Bombay, has joined the World Health Organization as its Assistant Director General

Mr Ram Rattan Aggarwal, M A of the National Physical Laboratory of India, has been awarded a Fellowship by the *National Research Council of Canada* for research in Ultrasonics Mr Aggarwal has carried out important theoretical work in Ultrasonics under the guidance of Dr S Parthasarathy and a few of his papers have been published in this Journal and in the *Proceedings of the Indian Academy of Sciences*

A 2,50 000-volt industrial X-ray plant capable of examining steels up to 3" in thickness, and lighter metals and alloys up to any thickness normally used in industry, has been installed at the Government Test House, Alipore, Calcutta The plant is available for utilization by Government Departments, public bodies and manufacturers Further information is obtainable from the Director, Government Test House, Alipore, Calcutta 27

Publications Received

Experimental Physical Chemistry (New Fourth Edition), DANIELS, MATHEWS & WILLIAMS, McGraw-Hill Book Co Inc , New York, $4 50

Electronics in Engineering, HILL, McGraw-Hill Book Co Inc , New York, $3 50

Communication Circuit Fundamentals SMITH, McGraw-Hill Book Co Inc , New York, $5 00

The Characteristics of Electrical Discharges in Magnetic Fields, GUTHRIE & WAKERLING, McGraw-Hill Book Co Inc , New York $3 50

Vacuum Equipment & Techniques, GUTHRIE & WAKERLING McGraw-Hill Book Co Inc , New York, $2 50

Fourier Methods, PHILIP FRANKLIN McGraw-Hill Book Co Inc , New York, $4 00

Electronic Valves — Book I Fundamentals of Radio-Valve Techniques, Philips Electrical Co (India) Ltd Calcutta, Rs 24

Electronic Valves — Book II Data & Circuits Philips Electrical Co (India) Ltd Calcutta, Rs 12

A Concise History of Astronomy, PETER DOIG Chapman & Hall Ltd , London, 21*s*

Electric Power System Control — Monographs on Electrical Engineering - Vol XI YOUNG, Chapman & Hall Ltd , London, 28*s*

Electrical Engineering Economics, Vol I — A Study of the Economic Use & Supply of Electricity (3rd Edition), BOLTON, Chapman & Hall Ltd , London, 25*s*

An Introduction to the Theory & Design of Electric Wave Filters, Chapman & Hall Ltd , London, 18*s*

ERRATUM

Review on *Technology of Light Metals*, by A Von Zeerleder (Elsevier Publishing Co Inc), 1950, Vol **9**, 62 Indian readers can obtain supplies of this publication from *Cleaver-Hume Press Ltd , London Price* 45*s*

Recent Work on Indian Oilseeds

THE Indian Oilseeds Committee was established by the Government of India in May 1947 for the improvement and development of the cultivation and marketing of oilseeds and for the production, manufacture and marketing of oilseed products. During the period under review, viz. year ended March 1948, the Committee have taken important decisions relating to production of oilseeds, oil-crushing industry, marketing and technological research. Prominent among these are the recommendations of the Committee to different provincial governments on ways and means to augment production of oilseeds without encroaching upon the acreage under food crops; improvements in the quality of oilseeds by evolving improved varieties; increasing the yield per acre and controlling pests and diseases, etc., by promoting agricultural research. In order to relieve the acute shortage of oil and fat supplies the Committee decided to take steps to fully utilize the *non-edible* oilseeds. To put the village oil-crushing industry on a sound footing and to improve the village *ghani*, an award of Rs. 5,000 has been announced by the Committee for the design of a suitable model of a *ghani* satisfying certain requirements. Further steps proposed in this direction are the organization of oil-crushing industry on a co-operative basis and the starting of an institution at Nagpur for imparting training in the extraction and processing of oils on a cottage industry scale. A sub-committee has also been constituted to suggest ways and means to develop this village industry and to protect it from competition from oil mills.

The supply position and efficiency of oil expellers was considered by the Committee and it was decided to take steps to improve the quality of expellers manufactured in India. The Indian Standards Institution has been requested to draw suitable specifications and to advise on the import of the material necessary for manufacturing standard oil machinery in India. Other important decisions taken by the Committee relate to standardization of oilseeds and oils for internal consumption as well as for export and formulation of technological research. The Committee also decided to import one "Windrum" fibre-making machine for the extraction of fibre from waste linseed straw.

The following is a brief account of the progress made during the year under review in agricultural research on oilseeds in different provinces under the auspices of the Committee.

In Madras the following improved strains of groundnut have been evolved: A.H. 25, A.H. 32, A.H. 698 and A.H. 334. These strains have recorded a 25 per cent increase in yield and oil content over the local varieties and are expected to bring an extra remuneration of Rs. 10 per acre to the cultivator. Strain A.H. 25 has been found to give a high percentage of fertilization. Extensive hybridization work is proceeding to evolve a strain with spreading habit combining high yield and thin shell. Seed dormancy studies have shown that bunch varieties can be used for seed purpose 10 days after harvest as about 90 per cent of seeds germinate after a week's drying. In the case of spreading varieties, the seeds can be used for sowing only after about 2½ months, as these require a resting period of about 2 to 2½ months. Viability studies have shown that groundnuts remain viable for about 4 years if the seeds are kept in air-tight containers. They lose vitality in about a year if stored under ordinary conditions in gunny bags. The geotrophic nature of gynophore has been found to be due to the development of certain bodies (plastids) in the epidermal cells of the gynophores after fertilization.

The following high-yielding strains of gingily have been evolved: S. 189, X-6 and X-38. A number of varieties have been crossed to evolve hybrids. Wider spacing of plants results in better developed branches and larger number of capsules and flowers per plant. Oil is found to form in the seed about 10 days after fertilization and rises to the maximum in about 30 days, i.e. about a fortnight prior to complete drying of capsules. There is also reduction in the acid value and moisture content of the seeds as the oil develops and reaches the maximum. Seeds from capsules at this particular stage of development are also found to give normal germination percentage. Gingily could, therefore, be harvested when the plants show first signs of yellowing without having the necessity to wait till the capsules are dry. Such harvest will prevent loss of produce due to shattering of seeds. Storage experiments have shown that (i) well-dried gingily seeds do not deteriorate to any marked extent when stored for a period of one year; and (ii) pure gingily oil, when stored in tins retains its colour and flavour up to 6 months. Later on it gets lighter in colour and begins to smell rancid. There is gradual increase in acid value which nearly doubles (7 per cent) at the end of one year.

The following high-yielding strains of castor have been evolved: R.C. 215, R.C. 58-8-1, R.C. 59-2-1-1 and C.O. 1. Extensive hybridization work has been taken on hand for the purpose of reducing the duration of crops still further and also to impart distinct pigmentation to the strains for easy identification. A number of progenies having the desirable combination of characters has been evolved.

In Madras, U.P., C.P. and Mysore, research work has been confined mainly to the evolution of the new types of oilseeds indigenous to the area by selection and by breeding. Of the 3 promising brown-seeded types of linseed, type 1193 was selected for distribution in U.P. Though fairly uniform, variations were noticed within narrow limits, and further selection of single plants started in 1939-40 showed the variations to be genetic and one of the variants of 1933, viz. 1193-2 has been specially selected which has been found to be suitable for the Bundelkhand tract. For the eastern districts the small-seeded improved type 477 is being distributed on account of its heavy yield.

The work of evolving aphis-resistant strains of mustard with high seed yield, high oil content and

(*Continued on page* 180)

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for March 1950

Inorganic Chemicals

42617 Manufacture of hydrogen peroxide *Electrolysing a solution of ammonium sulphate, sulphuric acid and one or more other soluble sulphates, and vacuum distilling the product* — Bernier

Organic Chemicals

42081 Laminated products from synthetic resins *Impregnating a surface sheet with a synthetic resin varnish, drying the same, spraying the sheet with a melamine-formaldehyde resin* — Formica Co

*40370 A process for recovery of useful by-products in the manufacture of enzymes with special reference to diastases *Macerating and extracting with water the microbial plant in which enzymes occur and precipitating the proteins with solvents like alcohol etc* — Raghavendra Rao & Sreenivasaya

41719 Manufacture of water-soluble sodium salts of carboxyalkyl celluloses *Sodium salt of a chloro-fatty acid and sodium hydroxide and sodium bicarbonate are added to cellulose in semi-moist condition* — I C I Ltd

41289 Isolation of chloesterol from wool-wax alcohols *Purifying from wax-like impurities by selective crystallisation or selective dissolution* — Organon Laboratories Ltd & Hewett

41349 Process for alcoholic fermentation *Yeast separated from fermented must is washed with water to remove buffering salts and asepticised with a mineral acid controlling* pH *value before returning to cycle* — Les Usines De Melle

42252 Process for producing dextran products for pharmaceutical and therapeutical preparations *Subjecting dextran to enzymatic degradation* — Aktiebolaget Pharmacia

Fuels & Lubricants

41694 Lubricating grease composition *Mineral oil, soap and* 1 *to* 20 *per cent by weight of oxidised petroleum, fraction rich in aromatics having aniline point of* 75°C *or less* — N V De Bataafsche Petroleum Maatschappij

Lumber & Wood Products

41299 Extraction of pectic substances from vegetable matter *Treating the vegetable matter in the form of column or bed with a solution of neutral salt of an alkali* — A S P Chemical Co Ltd

Printing, Publishing & Allied Industries

39833 Typewriters or teleprinters for Devanagri or like scripts *Type bodies which extend to the left or to the right to provide for overlapping letters or vowel symbols* — (Mrs) Misra

Rubber & Rubber Products

41872 Articles from rubber, rubber mixtures or like elastic material *Pressure is applied on a rubber plate on a mould having grooves so that the articles formed will have ribs on it* — Heijnen Den Bak & Laupman

42098 Rubber antioxidants *Condensing crude xylenols with aldehydes other than formaldehyde in the presence of an acid* — I C I Ltd

42148 Adhesives and process for bonding rubbers or other synthetic materials *Bringing the materials together in the presence of the compound of the* R(NHCOR 'R "COR"')n — I C I Ltd

42035 Production of latex articles in the cold *Ammoniated latex is treated with a ferment or ferment generating substance followed by zinc oxide* — Societe Auxiliaire De L Institut Francais Du Cautchouc

Stone, Clay & Glass Products

41892 Method for producing cement in powder form from granulated slag *Subjecting to a drying action supplemented by a dispersing action* — Trief

Textile & Textile Products

39841 Improved spinning machine *Imparting a slow motion to a traveller carrying the bobbin by a system of permanent magnets* — Narayanan

Miscellaneous

42391 Shot firing in mines and quarries *Bore hole which receives the cartridges is drilled with an extension of smaller bore at its end* — Victor Products (Wallsend) Ltd

41165 Manufacture of dolomite bricks *Sintered dolomite is mixed with a minor proportion of hydration inhibitors and a quantity of hydration inhibitors and a quantity of non-aqueous binder* — Moon

Patented Inventions of the Council of Scientific & Industrial Research

AIR SEPARATOR

Patent No 34692

G D Joglekar

Air separators are used for separating ground aggregates into different sizes These find application in the manufacture of dry cells, carbon products, ceramic materials and numerous other industries

The vane type air separators which are generally used have two cones, one inside the other, and a number of vanes for controlling the particle size The mechanism being intricate, these separators are generally costly

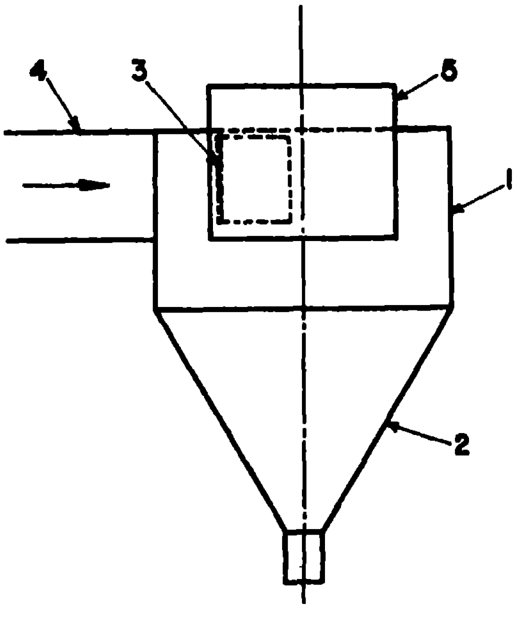

Fig 1

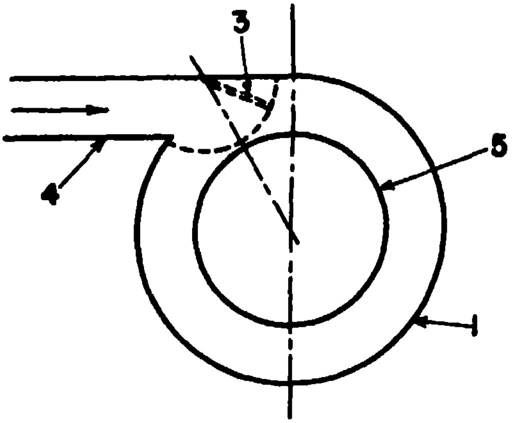

Fig 2

In the present invention a single vane is used to control the separation of particles into various sizes

The ground material is conveyed through an inlet into a vessel by means of air, a single vertical rotatable vane 3' (Figs 1 and 2) is fixed at or near the opening of the inlet into the vessel to regulate the direction of flow of particles and consequently the particle size discharged out of the separator through an upward outlet, heavier particles drop into the vessel The vessel has a cylindrical top portion and a conical lower portion The axis of rotation of the vane in fixed tangentially to the cone Air laden with particles is passed through the separator with the vane pointing at the required angle from the tangential The finer mass coming out of the upward outlet and the heavier particles which drop to the bottom are separately collected Particles are conveyed either by driving air through the inlet or by maintaining suction through the upward outlet

The present invention simplifies the manufacture of air separators and considerably reduces the cost It is of particular importance to small-scale industries

RECENT WORK ON INDIAN OILSEEDS — *Continued from page 178*

with low iodine value within the range prescribed for trade purposes was taken up by the Economic Botanist (Oilseeds) to the Government of U P T 4L. 16 has proved to be a good early type and its distribution has been started in U P T 11 has been distributed on a large scale in western and central districts These types are hardy and almost aphis resistant and their yield is 15-18 md seed per acre and oil content is 40-45 per cent Among the sarson strains T 30 is early, yellow seeded with a heavy yield AGH-A is a late, bold-seeded yellow sarson for the western districts, while toria and 4129 have proved to be good brown-seeded types

In order to co-ordinate research on oilseeds on an all-India basis, the Committee have under consideration the establishment of one or more Regional Research Stations A Central Research Station for dealing with fundamental problems and for co-ordinating the work done at different centres is also contemplated

Insecticides of Vegetable Origin

A REALIZATION of the somewhat unequal struggle for survival between the insect world and the internally disrupted and divided house of man loaded as the latter is with an incomprehensible urge for self destruction, appears to be of a fairly recent origin That such a formulation of the situation regarding the ultimate inheritance of the earth is not a matter of light-hearted witticism will be evident from the fact that the insect world far outweighs the human, weight for weight, carries disease and pestilence, destroys and eats up cultivated crops and stored food, causing losses assessable in almost astronomical figures Due to a growing appreciation of the acuteness of this situation increasingly greater organized efforts have been made since the beginning of the present century to fight back this aggression by the use of insecticides of mineral, plant and, comparatively more recently, synthetic origins In the course of this development progressively greater efforts have been directed towards the substitution of highly toxic materials like arsenicals and silico fluorides with products of plant origin which are comparatively less toxic to man and animals

In the search for plant insecticides, advantage has been taken of the fact that quite a number of plants, traditionally used by indigenous populations in various countries as fish poisons, have been shown to possess insecticidal properties in varying degrees While, however, the volume of researches based on such materials is colossal, the number of plants and plant constituents which have been actually established as useful and economically practicable insecticides, is strictly limited Apart from pyrethrum which, on account of its non-toxicity to man and animal and high knock-down value, remains by far the most effective and safe among all insecticides in use, others of commercial value are

I The alkaloidal plants (i) *Nicotiana rustica Nicotiana tabakum*, sources of nicotine, and (ii) the anabasine bearing plants *Anabasis aphylla* Linn, indigenous to Russian Turkistan and neighbouring countries of Central Asia, and *Nicotiana glauca* which grows wild in south west U S A

II Rotenone-bearing plants (i) certain species of derris, e g *Derris elliptica*, *Derris malaccensis*, *Derris trifoliata*, *Derris robusta* and *Derris ferruginea*, and (ii) various species of *Lonchocarpus*

I Although extensive use of tobacco extracts has been made for the control of specific agricultural pests, it is difficult to obtain reliable figures for the production of the extracts and of nicotine and nicotine sulphate in various countries Pre-war figures were roughly 1,000 long tons of nicotine sulphate in the United States, 100 tons of nicotine in Germany, 100 tons of nicotine sulphate in Japan and 735 tons of all categories of nicotine insecticides in the United Kingdom The records are, however, silent about U S S R which, none the less, appears to be the most important among the producers of the two alkaloidal insecticides, with almost a monopoly for anabasine production, and nicotine production probably comparable with that of the U S A No such industry exists in India, and although farmers in the country have been advised by agricultural departments in various States to use aqueous tobacco extracts for crop protection against insect pests, it is extremely doubtful if this good advice has been followed up to any record-worthy extent by the resourceless and illiterate peasantry

II The use of derris roots is of comparatively recent origin, the chief producing countries before World War II being in the order of importance Malaya Indonesia Philippines and Sarawak *D elliptica* and *D malaccensis* are grown in these countries and production in Malaya in 1938 was estimated at 4 000 tons While many species of derris are indigenous to India they have been found to be inactive with the exception of *D ferruginea* which grows in Assam but this species also contains only 3 per cent of rotenone a rather low figure for the active principle Considering the success however of experimental cultivation of *D elliptica* and *D malaccensis* in Mysore and U P it may be presumed that serious efforts will be made to bring these species under cultivation in suitable climatic areas of the country in sufficient quantities to meet the internal requirements and also for export

Among the rotenone bearing plants there is a growing competition to derris from various *Lonchocarpus* species (e g *L utilis L urucu L martinii* and *L sylvestris*) in spite of their lower rotenone content The comparative import figures for U S A in 1938 were 1 042 tons of derris and 850 tons of lonchocarpus While the present production of lonchocarpus appears to be limited to the South American countries Columbia Peru Equador and Brazil Malaya has shown sufficient promise for the cultivation of certain species of lonchocarpus and it should be worth while to study the possibility of its cultivation in similar climatic areas in India

Pyrethrum

Experimental cultivation of pyrethrum in India has shown that crops grown in Assam Mayurbhanj Kodaikanal and Kashmir yield flowers with high pyrethrin content ranging from 1 4 per cent in Assam to 0 95 per cent in Kashmir as against 1 3 per cent and 0 9 per cent in flowers from Kenya and Japan respectively The production of pyrethrum in Kashmir which was 0 2 tons in 1940 41 steadily increased to 79 2 tons in 1945 46 It appears however that there has since been a considerable decline in the cultivation of pyrethrum in Kashmir on account partly of unsettled conditions in the area but mainly due to the fact that no interest has been shown in its industrial exploitation It may also be contended that the advent of synthetics like DDT and hexa chloro benzene has been chiefly responsible for this situation but while there is some truth in that contention the health hazards of these chlorinated highly toxic compounds definitely rule out their use in all cases of pest control directly or indirectly connected with food consequently pyrethrum products have every assurance of this specific sphere of utility in addition to their use in some anti malarial measures

In contrast to the drastic attitude of the Food & Drug Administration and other scientific men and organizations in U S A towards DDT* there is a considerable body of scientific opinion which considers a proper use of it within the limits of tolerance as quite harmless and all this fuss about health hazards as rather hysterical Assessing the pros and cons of the whole controversy however and considering further that such a proper use of highly toxic synthetic insecticides is likely to be somewhat more precarious and difficult of achievement in the present state of agricultural and dairy organizations in India than in the U S A it will be advisable to err on the side of caution

Taking into account all the facts stated above it appears imperative that in all pesticidal measures in India we should concentrate on the development of insecticides

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* It will not be out of place here to give a few relevant extracts from recent reports from U S A relating to health hazards of some synthetic insecticides

Charles W Crawford Commissioner Food & Drug Administration (FDA) emphasized the great responsibility which manufacturers and users of agricultural insecticides face in making sure that national food supply will not be contaminated nor national health endangered by the application of hazardous insecticidal products on foodstuffs Too many products presenting toxicity problems have been rushed into manufacture and use before being thoroughly tested Every phase of the toxicity problem must be thoroughly investigated even though necessary research is expensive and time consuming before new insecticides are offered for use He is further reported to have said that liver damage has been shown to result from DDT at levels lower than 7 p p m (*Agricultural Chemicals* 1949 4 No 1)

It has been clearly shown that DDT appears in the milk fat when DDT sprays are used in dairy products and on dairy cattle or when fodder bearing DDT residues is fed to cattle DDT is a poison and its use under conditions which would contaminate milk a food so universally used by infants and children would be contrary to the *Food Drug & Cosmetic Act* (*Agricultural Chemicals* 1949 4 No 2)

Many scientific publications emphasize that DDT or any other insecticide must be used properly Fruits and cereal crops should be treated long before harvest with no more than the of vegetable origin limiting the use of synthetics to the barest practicable minimum Concentrated efforts should be made for the cultivation of pyrethrum and other well established insecticidal plants and for the standardization of their extracts and preparations on the one hand and industrial utilization of tobacco waste for the manufacture of standardized extracts as well as nicotine and nicotine sulphate on the other

While limiting attention to the use of these well established plant insecticides a large amount of investigation can be carried out and should be carried out for evolving the best possible modes of application of insecticides as the manner of application is known to have profound influence on their effectiveness For instance the phenomena of synergism in respect of various insecticides needs a thorough and comprehensive study Further the particle size of the active principles in sprays and their wetting and spreading properties are of importance in extending the usefulness of insecticides and there is considerable room for research in this direction A brief reference to some instances of the work carried out in the Chemical Laboratories of the *Council of Scientific & Industrial Research* may not be out of place in this connection

1 An emulsifier was evolved during the War for the production of biologically stable emulsion sprays from pyrethrum extracts which when tested by the *Malaria Institute* were found to retain their activity for about a year as against the usual soap emulsions of pyrethrum extracts which deteriorate in their activity within 36 hours As ascertained through systematic laboratory and field work by the *Malaria Institute* this emulsifier did not only stabilize the pyrethrins in emulsion sprays but also activated them to such an extent that sprays with only 0 025 per cent of pyrethrins gave mosquito kills achieved with 0 1 per cent in the case of kerosine extracts of pyrethrum

2 By employing a stable mixture of solvents easily available in India it has been possible to get higher concentrates of pyrethrum varying from 10 to 12 per cent according to the pyrethrin content of the flowers

3 Studies in the stabilizing action of bhilawan and cashew shell liquids and products derived from them on pyrethrum extracts and products have definitely shown that sulphonated bhilawanol is a cheap and invaluable antioxidant for stabilizing pyrethrins

4 A biologically stable mosquito repellent semi vanishing pyrethrum cream was formulated which fulfilled all the requirements stipulated by the *Malaria Institute* during the War

5 On a reference from the *Malaria Institute* an emulsifier was evolved for the production of emulsion sprays from DDT which were stable over long periods DDT emulsion sprays produced with this emulsifier which was principally based on the use of oleoresin in its formulation conformed to all the specification tests needed of such emulsions

While some of the processes referred to were actually patented and used with great

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recommended amount of poison In milk shed areas the problem is more complex for cows may eat fodder treated with insecticides and the compounds may be carried in milk According to all reports milk farms and dairy herds should not be dusted or sprayed with DDT

There are three pesticides benzene hexachloride organic mercury and selenium compounds which we will not knowingly accept in any detectable trace by flavour odour or chemical determination Final acceptance of all purchases of fruits and vegetables will be subject to our laboratory analysis and approval (*Agricultural Chemicals* 1949 4 No 3)

Paul B Dunbar United States Food & Drug Commissioner stated that widespread use of DDT since the War has exposed the public to small continued intakes from many sources for long periods How serious this hazard may be in terms of human damage is not known Rats fed with 1 p p m of DDT will during their normal life time store DDT in fat Minimum but characteristic liver damage was noted in feeding 5 p p m Female dogs exposed to cumulative effects secrete DDT in their milk Mother rats fed 50 p p m or more of DDT produce smaller offsprings with fewer survivals than control animals For toxicity studies the FDA assumes that similar results might occur with human beings

Experiments conducted by the Bureau of Entomology & Plant Quarantine showed that milk from cattle which eat silage bearing DDT or cattle sprayed with it or cattle kept in barns where DDT is used contains DDT In view of recent toxicological data on the cumulative effects of small doses of DDT the FDA has had to revise its prior view that with proper precautions to protect the food from contamination DDT was a safe insecticide to use in producing all types of foods Since milk is a universal food and the principal food of babies and children the FDA will not set up a tolerance for DDT in milk Fortunately there are alternative and less objectionable substitutes for use in milk production (*Chemical & Engineering News* 1949 27, No 20) advantage during the War, none of them has been taken up for exploitation by industry under peace conditions. On the other hand, the fruitful collaboration between the *Malaria Institute* and the Chemical Laboratories of the *Council of Scientific & Industrial Research*, which was mainly responsible for all this development during the War, also gradually waned off in peace time This was particularly unfortunate, because it is only through collaboration of this kind between chemists and entomologists that we can at all get to any worth-while results in the field of plant or synthetic insecticides

Another line of work, which was being followed in the Chemical Laboratories of the *Council* till recently, was directed towards the study of chlorination and nitration products derived from bhilawanol and cashew shell liquids, the principal constituents of which are hydroxy benzene derivatives with straight unsaturated $C_{15}H_{27}$ side chains Like chlorinated terpenes and some nitrated phenols, these products also appeared to give promising results, but for various reasons over which the investigators had no control, this work has come to a halt It appears, however, that other laboratories might take up this work with advantage, as these products are based on raw materials in the production of which India holds a virtual monopoly, and they may have some application in specific cases, where other plant insecticides are, for some reason or other, not effective or practicable

Notwithstanding the fact that most of the work on insecticides during nearly the whole of the last decade has been directed towards the synthetic field, quite a considerable amount of investigation still continues to be carried out on insecticidal plants While in the present note emphasis has been laid on investigations and development of commercially well-established plant insecticides, it is by no means suggested that work at various research centres in India on the search for new insecticides of vegetable origin or even synthetics should receive no attention What is emphasized is that in the present situation, faced as we particularly are with paucity of research personnel and difficulties in the way of collaboration between chemists and entomologists, it will be advisable to recognize the limitations, and throw the whole weight of our organized effort on cultivation and development of well-established plant insecticides

S SIDDIQUI

Caustic Soda Industry in India

S G SASTRY

Bangalore

CAUSTIC soda occupies among the basic chemicals a position equal in importance to sulphuric acid, ammonia and superphosphate In all the advanced countries of the West, e g Germany, England and America, the production of caustic soda runs to millions of tons a year, and serves as an index of the highly advanced state of the chemical industry in those countries In this respect India's place among the producers of this chemical is woefully backward

The present demand for caustic soda in India is estimated to be 70,000 tons a year, while the production in the country is not more than 10,000 tons a year. The balance of 60,000 tons is obtained by imports mainly from England and, more recently, from America, Belgium and other countries

From the national point of view, it is imperative that we should expand this industry in India, and every encouragement should be given to those who have started manufacturing this important key chemical

Any assistance or protection given to the manufacture of caustic soda in India should not in any way increase the burden of the consumers by increasing the cost of imported article in the form of protective duties The only logical way to assist the industry will be in the form of a subsidy, to be paid in arrears, on the actual tonnage of caustic soda produced and sold by each factory The quantum of subsidy to each factory will depend on its location and concomitant manufacturing conditions This procedure has already been adopted by the Government who, on the recommendation of the Tariff Board, granted an *ex gratia* subsidy to the *Mettur Chemical Corporation* when they applied for assistance two or three years ago

When granting the subsidy, strict conditions should be laid down that the Indian manufacturers will introduce all economies possible and make provision for the expansion of the industry simultaneously by the import of up-to-date machinery and equipment

Caustic soda can be manufactured by two methods (a) starting with soda ash or sodium carbonate and causticizing with calcium hydroxide or hydrated lime This gives a dilute solution of caustic soda, which will have to be evaporated to obtain solid caustic soda The success of the process depends on the purity of lime used for causticizing, the cost of fuel, and the scale of operations, (b) electrolysis of common salt The only raw material required is common salt, power should be available at cheap rates The snag in adopting the process in India is the disposal of chlorine that is produced simultaneously with caustic soda. For every 23 tons of caustic soda 20 tons of chlorine are obtained The chemical industries in India which can utilize large quantities of chlorine are few Bleaching powder is required in the textile industry, but the consumption of bleaching powder has suffered due to competition from hydrogen peroxide. Chlorine is used for water purification, but the actual tonnage used for this purpose is small The paper mills require both caustic soda and chlorine, but all the progressive paper mills have their own electrolytic alkali plants of the size required to meet their requirements The caustic soda required by the rayon industry should be of the highest grade of purity, and for this purpose it is usual to use mercury cells instead of diaphragm cells for the electrolysis of high purity sodium chloride

I would earnestly appeal to the Tariff Board to investigate why the causticization method should not be adopted to a far greater extent, and the existing facilities enlarged for a greater output The immediate advantage will be the increased production of soda ash or sodium carbonate, thereby bringing down the price of sodium carbonate By calcining the lime carbonate that is obtained as a by-product in rotary kilns, the carbon dioxide required for sodium carbonate manufacture can be secured and the calcium oxide re-used for causticizing purposes The annual output of soda ash in Dhangadhra and in Mithapur is reported to be 50,000 tons each If either of them can double the output and the extra 50,000 tons of soda ash used to prepare caustic soda on the spot, we shall be able to produce an additional 37,500 tons (approx) of caustic soda in the country

Generally speaking, the cost of producing caustic soda in India by any of the processes is much higher than in other countries There are several reasons for this (a) to begin with, our capital costs in India per unit production are higher than in other countries, (b) our scale of operations is small and the proportion of overhead expenses and salaries of technical staff is proportionately high, (c) neither high purity common salt nor high purity lime is available in India. The cost of purification of common salt and the disadvantage of using low-grade lime add substantially to the unit cost of production, (d) the cost of fuel in India is higher than in other countries, (e) the freight charges on Indian railways are high and this adds to the cost of production, and (f) except in Mysore and at Mettur the cost of electric power is high

The important requirement is to step up the scale of operations and thereby bring down the price of the product It is unfortunate that even in areas where there is a sizable demand for caustic soda, the industrialists do not co-operate with each other and participate in a common endeavour Take for example the city of Bombay with its textile mills, soap factories, vegetable oil refineries and the new rayon factory The total annual demand of these and a large number of other industries requiring caustic soda will come to at least 10,000 tons Yet, we have not got one large caustic soda factory with this output Apart from the advantage of large-scale production, there will be an important saving in the cost of fuel. Instead of evaporating the liquor to solid caustic soda involving heavy expenditure on fuel, the caustic soda required by the factories can be supplied as liquor in tank wagons If the manufacturers do not co-operate, the Government of India should establish a large caustic soda plant within the Bombay area and compel all users of caustic soda and chlorine to get their supplies from the Government factory

It should be possible to have jointly owned caustic soda factories at Ahmedabad, Coimbatore, Bangalore Calcutta Kanpur and Delhi If these co operative or jointly owned factories come into existence, we may gradually do away with imports of caustic soda

The Geological Survey of India are carrying out a survey for new sources of high-grade lime This work will have to be intensified India is depending mainly on sea salt for her industrial needs and the salt manufactured is unfit for chemical industries The Government of India should take steps to improve the methods of salt manufacture Research in this direction was started under the auspices of the Council of Scientific & Industrial Research but the problem does not appear to have been pursued to its logical end The Council of Scientific & Industrial Research should undertake investigations on the problem of high purity sodium chloride and also explore the possibilities of utilizing surplus chlorine in industry

Environmental Factors & Human Comfort

N K PATWARDHAN

Building Research Unit, C S I R Roorkee

A MEETING of the scientific officers of the Commonwealth* countries was held in London on 7th February 1949 to consider the problem of physiological and other factors affecting the working and living of people in tropical countries Some work was already begun in Australia on these lines and it was decided that the Commonwealth Experimental Building Station Australia should work as a co-ordinator for all data Almost all the Commonwealth countries are taking part in this project †

As a result of discussions at the Conference, the following problems were considered worth investigation

1 By what means can environments be compared ?

2 What are the effects of different environments on physical comfort (or discomfort) and efficiency ?

3 To what extent do clothing and rate of activity influence (2) ? and

4 can charts be developed to provide answers for (1), (2) and (3) for summer temperatures ?

Research programmes have been drawn up and work initiated in the following institutes

1 Royal Naval Personnel Research Committee of the Medical Research Council of Great Britain Useful data have been collected on the effect of high temperature and humidity on naval personnel

2 Commonwealth Experimental Building Research Station Australia

(i) Development of thermal models for predicting the effects of insulation shading ventilation and weight of construction in dwellings

(ii) Thermal behaviour of industrial type buildings

(iii) Air cooling in summer and air warming in winter by passing air through pipes buried in the ground

(iv) The study of the attic-fan system of cooling for Australian conditions

3 The National Building Research Institute, South Africa, considers the following problems as urgent and important

(i) What is the most suitable criterion for thermal comfort in severely hot climates ?

(ii) Having decided on (i), which of the existing methods of assessing environmental warmth in terms of a comfort scale is the most reliable means of comparing environments under these conditions?

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* British Commonwealth Scientific Officers Conference

† Building Research Unit (C S I R) Roorkee represents India in this project

(iii) What are the effects of various physical factors of a thermal environment on human comfort and efficiency and what is the relative importance of each in these respects?

(iv) To what extent do clothing and rate of activity influence (iii)?

(v) Special building problems which arise as a result of high intensity of solar radiation in the African continent. These are (a) comfort studies and design of buildings and (b) design of buildings to meet seasonal requirements.

4. *Work done in India* — Considerable amount of original work has been done by the Industrial Health Research Unit of the Indian Research Fund Association[1] on the effect of environmental conditions such as lighting, temperature, humidity, ventilation and dust on the comfort of working in certain industrial establishments in and around Calcutta. Reduction in noise has been found to increase the output in jute mills. The comfort ranges of different environmental factors have been studied. The British and American indices of comfort are not strictly applicable to Indian conditions.

The design of kitchen in buildings in India demands special attention. Smoky kitchens which are common in India are a source of discomfort. The Hyderabad Engineering Research Laboratories[2] have examined this problem in considerable detail.

The factors leading to fatigue and efficiency in paper and textile mills are being investigated at the Laboratories of Experimental Psychology, Lucknow University. Similar studies are also being carried out in the Calcutta University.

Problems concerned with the physiology of air force and army personnel are being investigated under the auspices of the Defence Department.

Researches on the utilization of earth stored heat for cooling in summer and heating in winter are being carried out at the Building Research Unit (C.S.I.R.), Roorkee[3]. Useful information regarding house construction and thermal comfort in north India has been collected[4]. As a result of the above observations the following conclusions are justified:

1. There is no relationship between high ceilings and summer comfort for masonry residences. The height of ceilings may without inconvenience be reduced to 9.

2. A two storeyed plan even for small houses needs serious consideration. If the house is to have six or more rooms a central hallway with doors opening from it into all the rooms is recommended.

3. All doors should normally be single leafed and about 2¼ × 6¾.

4. There should be at least 4 sq. ft. of transom space between every room and its adjacent room with which it communicates within the house. This will afford through ventilation near the ceiling level. Transoms can be made in the spaces between doors and ceilings.

5. Every living room should have liberal window space reaching at least from a height of 4 to 8 from the floor.

6. Porch shading for the summer sun is recommended. The porch should be so designed that it would not hinder sunlight during winter. If porch shading is not feasible for a window it should be provided with a hinged shutter shade on the outside.

7. Rooms should have windows rather than doors for light and air. Windows can be provided with screens.

Data are being collected at the Building Research Unit on comfort conditions in village houses in India. Work is also in progress on the development of sun-dried roofing tiles suitable for village houses[5].

It is suggested that the physiology departments of medical colleges in India should collect data on the physiology of clothing and other factors affecting the life and work of people in their respective areas. Climatic surveys should also be conducted under the aegis of the Meteorological Department and comfort charts for different areas prepared which would help architects and building engineers in designing buildings.

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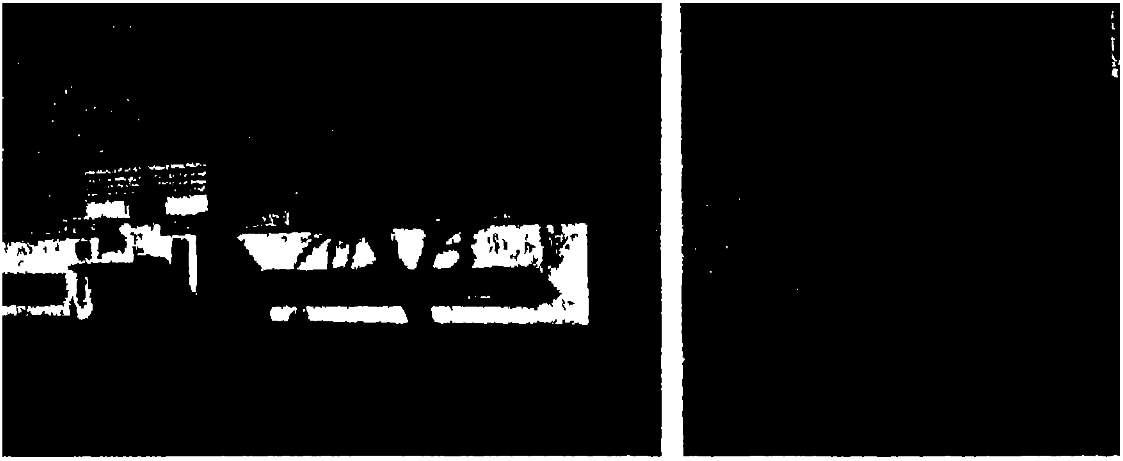


THE NATIONAL FUEL RESEARCH

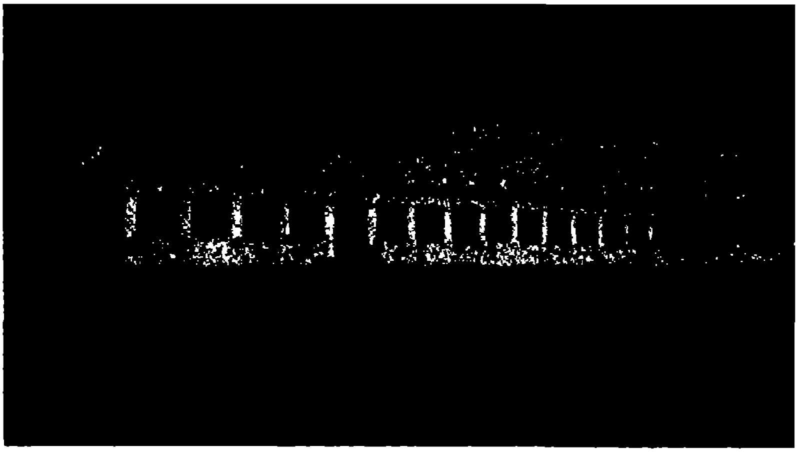
OPENING CEREMONY,

THIRD in India's chain of National Laboratories, the National Fuel Research Institute, Digwadih (Bihar), was declared open on April 22, 1950, by the President, Dr Rajendra Prasad The foundation-stone of the Institute was laid on November 17, 1946

The establishment of the National Fuel Research Institute fulfils a long-felt need and satisfies a demand that has persisted for some decades India has large supplies of iron ore Her supplies of coking coal, however, are not over-abundant The efficient utilization and conservation of these, besides research into the up-grading of coking coal by mechanical processes are, therefore, of considerable importance Successive Coal Commissions in 1928, 1936 and 1946 urged the scientific investigation of these problems, and the Fuel Research Committee of the *Council of Scientific & Industrial Research*, constituted in 1940, examined the question in detail and recommended the establishment of a Fuel Research Station Dr S S Bhatnagar, Director of Scientific & Industrial Research, proposed to the Government of India in 1941 the establishment of a Fuel Research Institute as one in the chain of National Laboratories in the post-war development programme The Government of India accepted this recommendation, and sanctioned grants for the purpose in 1944 The Institute was fortunate in securing the services of Dr J W Whitaker as Director, who assumed charge of his duties in April 1946

Fuel research was being actively pursued under the auspices of the *Council* in temporary laboratories at Dhanbad during the last three years, and valuable results have already been obtained A beginning was made with the physical and chemical surveys of Indian coals Detailed studies were undertaken on the washability of coal from Jharia, Raniganj, Bokaro and C P coalfields, and experimental work initiated on the manufacture of synthetic petrol by the Fisher-Tropsch process This work, besides helping in the training of necessary personnel, laid the foundation of a sound procedure in the sampling, analysis and testing of Indian coals Under the aegis of the Fuel Research Committee, two valuable reports, *The Washability of Indian Coals* and *The Blending of Coals for Coking*, have been published A handbook on *Indian Coals* containing all available information in a classified form, has been issued

The National Fuel Research Institute is situated amidst picturesque surroundings on a 170-acre estate, a generous donation by the Raja of Jharia. The laboratories have been carefully planned The layout allows for centralization of services and stores, and permits expansion of the building to 2 or 3 times the present floor area Simplicity, convenience and efficiency have been the considerations which have governed the



INSTITUTE, DIGWADIH

APRIL 22, 1950

design and layout Refrigerative cooling has been adopted for the air-conditioning of the laboratories because of the high humidity of the atmosphere during the summer and monsoon seasons Care has been taken to prevent the possibility of noxious fumes from one laboratory being discharged into another The laboratories are built on a unit basis, each unit or room accommodating 2 research workers and 2 assistants The walls dividing the laboratories are of comparatively light structure and easily removable so that, should it be desired to convert two or three rooms into one large laboratory, the change-over can be effected with ease The water supply is drawn from a well, 15′ dia × 120′ deep, and pumped into a reservoir in which the pressure is developed by means of entrapped air An automatic device has been installed for maintaining the necessary pressure The system is economical, gives water at high pressure, and obviates the need for the construction of a water tower Residential accommodation has been provided for the staff on the estate

Dr J W Whitaker Director, National Fuel Research Institute

The scope of the Institute covers the whole field of fuel research — fundamental and applied — but for some time to come the Institute will pay greater attention to coal and its by-products The short-term programme includes the rapid physical and chemical survey of Indian coals, their washability, coking and blending Low, medium and high temperature carbonization and gasification on selected seams will be studied with a view to immediate exploitation of the results The long-range programme embraces a detailed survey of Indian coals, investigations on their carbonization and coking properties, deterioration of coal during storage and weathering, de-ashing

Dr Rajendra Prasad, the President of the Indian Republic, opening the Fuel Research Institute

and preparation of coal for the market, steam-raising and pulverized fuel-firing and briquetting. Hydrogenation and oxidation of coal to obtain synthetic petrol, lubricants and material for the production of dyes, plastics, pharmaceuticals and allied products will form an important part of the research programme.

The work of the Institute is to be carried out in 6 main divisions, viz. (1) Coal Survey and General Analysis, (2) Carbonization and By-products, (3) Liquid Fuel (including hydrogenation of coal, synthetic fuels, petroleum and substitutes), (4) Physics (including X-ray studies and spectroscopy), (5) Gaseous Fuels (including gasification), and (6) Engineering (including preparation of coal for the market, coal-washing, boiler plant, combustion engineering, etc.). In addition, there will be, under the control of the Fuel Research Institute, the following 6 Regional Coal Survey Stations to conduct physical and chemical survey of coals: (1) Dishergarh (Raniganj Field), (2) Digwadih (Jharia Field), (3) Ranchi (Bokaro-Ramgarh-Karanpura Fields), (4) Umaria (Eastern States Coalfields, Vindhya Pradesh), (5) Kamptee (Central Provinces Coalfields), and (6) Dibrugarh (Assam Field).

Discussing some aspects of fuel research, Dr J. W. Whitaker referred in particular to the schemes on low and high temperature carbonization and by-product recovery, experimental hydrocarbon synthesis, coal-washing and pulverized fuel research. The implementation of these schemes needed considerable funds. "Fuel technology", he observed, "is essentially a branch of chemical engineering and to attempt engineering without plant is to build castles in the air. At the laying of the foundation-stone, I indicated that the minimum expenditure on the Institute would be of the order Rs 15 to 20 lakhs per annum. The expenditure in other coal-producing countries of the world is far higher. In America, it is about Rs 1,000 lakhs, in Great Britain, Rs 100 lakhs. The question is, 'How can Rs 20 lakhs per annum be raised in India?' A suggestion which would appeal to all is that the coal itself should largely provide for the research into its own best uses. A levy of one per cent or even half of one per cent on the price of coal should be made, and the funds devoted to research, i.e. to the investigation of how such fuel may be best utilized for the country's good.. Let us take half of one per cent, i.e. one anna per

TABLE I

MONTH & YEAR	DATE	HOURS	$f^{\circ}E_s$ Mc.	hE_s Km
March 1950	1	19 00	3 20	105
	3	17 00	3 30	105
		18 00	3 25	105
	6	12 00	10 50	150
		14 00	6 00	150
		15 00	5 00	135
		17 00	3 75	135
		18 00	4 00	135
		19 00	3 00	120
		20 00	3 00	105
		22.00	3 00	105
	7	18 00	3 30	105
		20 00	3 00	105
		22 00	3 20	105
	8	08 00	4 00	105
		10.00	6 00	120
		11 00	6 25	120
		12 00	6 25	120
		19 00	3 45	105
		20 00	3 60	105
	9	07 00	2 85	105
		20 00	4 25	105
		23 00	5 00	105
	10	00 00	4 00	90
		01 00	3 25	90
		06 00	6 00	105
		17 00	3 30	105
		21 00	4 00	105
	11	08 00	4 25	105
	13	21 00	2 45	90
		22 00	2 50	90
	14	15 00	3 85	120
		16 00	3 80	105
		18 00	3 25	105

TABLE I — contd.

MONTH & YEAR	DATE	HOURS	$f^{\circ}E_s$ Mc.	hE_s Km
March 1950	15	00 00	3 00	90
		07 00	3 50	105
		09 00	6 00	120
		19 00	4 30	105
		20 00	4 20	105
		21 00	4 75	105
		22 00	3 90	90
		23 00	3 50	90
	16	23 00	3 30	90
	23	08 00	4 00	105
		10 00	6 00	120
		19 00	4 10	105
		20 00	4 00	105
		21 00	4 00	105
		22 00	4 20	105
		23 00	3 65	90
	24	00 00	3 00	90
		07 00	2 75	105
		20 00	3 50	105
		21 00	3 23	90
		22 00	3 30	90
	28	02 00	3 20	90
		16 00	4 25	120
		17 00	4 25	120
		18 00	3 80	105
	29	19 00	3 60	105
		20 00	3 50	105
		21 00	3 85	105
		22 00	3 85	90
		23.00	3 00	90
	30	00 00	3 00	90
	31	18 00	3 50	105
		20 00	4 00	105
		22 00	4 25	105

Production of Nicotinic Acid in India*

N RANGASWAMY† & B H KRISHNA‡

NICOTINIC acid, an important member of the vitamin B group, has been prepared from a variety of starting materials such as nicotine, pyridine, β-picoline, quinoline and 8-hydroxy quinoline

Of the several methods of production, mention may be made of the oxidation of nicotine and 8-hydroxy quinoline with nitric acid, and of quinoline with potassium permanganate or hydrogen peroxide These processes are reported to be used in Germany to a large extent[1]. Quinoline and pyridine are used as starting materials in America[2] Quinoline is oxidized in the liquid phase with sulphuric acid using selenium as catalyst, and pyridine is brominated in the vapour phase to yield 3-bromopyridine which is then converted to cyano-pyridine, hydrolysis of cyano-pyridine under controlled conditions gives nicotinamide or nicotinic acid

Investigations have been conducted by us on the economic aspects of raw materials for the production of nicotinic acid Nicotine has often been suggested as the starting material Tobacco waste containing sufficient nicotine is not available at sufficiently low prices to make the extraction of the alkaloid economical in competition with quinoline or pyridine Comparatively larger quantities of chemicals are required for oxidizing nicotine, and under the conditions obtaining in India at present, nitric acid, potassium permanganate and hydrogen peroxide are prohibitively expensive

It is interesting to mention here that selected varieties of tobacco containing as high as 10 per cent nicotine (on dry leaf basis) are grown in Germany and utilized for the production of nicotinic acid[3] Also the process of vapour phase oxidation of nicotine to nicotine nitrile in the presence of vanadium pentoxide catalyst is claimed to give an yield up to 51 5 per cent of the theoretical[4]

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* Abstract of a paper received for publication in July 1949 The publication of the paper was withheld at the authors' request

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‡ Development Officer, Indian Penicillin Committee, Haffkine Institute, Bombay

Preliminary investigations have shown that catalytic liquid phase oxidation of quinoline with sulphuric acid offers the most promising method for the production of nicotinic acid in India at prices comparable to those prevailing in the United Kingdom or Germany The process has the advantage of utilizing materials easily available by import or producible in India and the process could be adopted for oxidizing nicotine from tobacco wastes

Quinoline from coal tar is available at present at prices more favourable than that produced by synthesis The synthetic production of quinoline was however studied in detail so that should necessity arise a process for the production of this basic material from aniline glycerol and sulphuric acid readily available in India may be at hand for exploitation Yields as good as those reported from Germany were obtained

The results obtained by previous workers[5] show that no well-defined correlation exists between nicotinic acid yields on the one hand and the concentration of sulphuric acid temperature time of reaction and the quantity of catalyst used on the other Using 4 to 14 lb of quinoline per batch several experiments have been carried out to obtain data on which pilot plant trials can be based It was possible to work up these quantities in glass flasks by dropwise addition of quinoline (purity 95 per cent) in sulphuric acid after the start of reaction and still to maintain the temperature conditions for continuous oxidation

The reactions were carried out in 20 to 50 litre flasks heated electrically by mantles The selenium formed a silvery pool at the bottom of the flask and the liquid above was continuously agitated to ensure uniform reaction and to prevent breakage of the flask The gases evolved consisting of sulphur dioxide carbon dioxide and water vapour were cooled in a tubular condenser The water was collected in a receiver and the sulphur dioxide was absorbed in a solution of soda ash A continuous draft was maintained by a pump The reaction was stopped when the approximate theoretical quantity of water was collected At this stage the temperature of the reaction mixture was in the range of 305° to 310°C Beyond 285°C a small quantity of selenium escaped as a fine red spray and settled on the walls of the condenser and the receiver The end of the reaction was marked by foaming of the mass The residue in the flask was withdrawn diluted under vigorous agitation and the tarry matter filtered off The filtrate was neutralized with sodium hydroxide filtered again and decolourized with carbon The nicotinic acid was precipitated with copper sulphate as copper nicotinate which was filtered washed and decomposed with hydrogen sulphide in an aqueous suspension The sludge of copper sulphide was filtered off and the nicotinic acid obtained from the filtrate by concentration and crystallization

The overall yield of nicotinic acid in these experiments was between 50 to 60 per cent of the theoretical Agitation of the reaction mass had a pronounced effect on the yield but with the laboratory set up of the dimensions described it was not possible to provide efficient agitation as could be easily accomplished in a pilot plant or semi works scale Yields up to 75 per cent have been reported in American manufacturing practice[2]

Our work has confirmed the possibility of making nicotinic acid in India at a reasonable cost

The results of our investigations are sufficiently encouraging to justify the installation of a pilot plant with a capacity of 15 000 to 20 000 lb of nicotinic acid per annum for obtaining further data

The authors are indebted to *Messrs Sarabhai Chemicals* Baroda in whose laboratories these investigations were carried out

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Rubber in Industry—a Survey of the Applications of Research

JAMES LAWRIE
Editor, "Chemical Products"

THE steadily increasing use of natural rubber in a wide variety of manufactures is the direct result of research, much of which has been conducted in Great Britain, notably at the Welwyn Garden City laboratories of the *British Rubber Producers' Research Association* Here, the Director, Dr Geoffrey Gee, has investigated the nature of an oil-resisting rubber with considerable success A rubber molecule is long and chain-like possessing a high degree of flexibility Within limits the molecules vibrate, relatively infrequently they separate sufficiently to slide bodily over one another

A piece of vulcanized rubber, dropped into benzene, swells to several times its size but retains its shape With raw rubber a further stage ensues, in which the rubber flows and ultimately disperses Inevitably one tends to form a picture of the rubber attracting and holding the liquid with some strong force This picture is now believed to be entirely false and an alternative explanation of the phenomena of swelling and solution has been given

Rubber, from the standpoint of solubility, is a liquid This may seem surprising, but its mechanical properties make it clear that the rubber molecules have a good deal of freedom to slip past one another, which is just the characteristic that is associated with the liquid state The absorption of oil by rubber is thus to be regarded as the mixing of two liquids — rubber and oil The problem to be solved was whether there is really some force of attraction between the rubber and the oil or whether these liquids mix because of their thermal motion

If we consider the mixing of two liquids, a factor becomes important The molecules of a liquid are close together and, therefore, exert strong forces on one another These are measured by the cohesive energy density (C E D), equal to the latent heat of evaporation per c c As different liquids do not have the same C E D, it must be concluded that their molecules cohere with different energies depending partly upon the chemical nature of the molecules and partly on the way they pack together Mixing two liquids involves changes in these intermolecular forces by bringing unlike molecules close together and these are reflected in the absorption or evolution of heat For many types of liquids it is found that the controlling factor is the difference between the C E D of the two liquids The sign of the heat change involved in mixing offers very direct evidence as to whether mixing is due primarily to thermal energy or to specific attraction forces The heat of mixing rubber with a liquid can be calculated from accurate measurements over a range of temperatures of the vapour pressure of the liquid above mixtures of rubber and liquid Applied to the system natural rubber + benzene, this method shows that

(a) the thermal mixing tendency (entropy of mixing) is very large, and
(b) that heat is *absorbed*

Thus the picture of rubber offering a strong attraction to the oil is completely wrong Any such attraction would mean that the increase of energy would be negative, and it is found to be positive The true explanation of the imbibition of oil by rubber is the same phenomenon as underlies the mixing of simple gases and liquids, namely an increase in entropy brought about by the natural tendency of molecules to mix by thermal motion The fact that swelling occurs has nothing to do with any attractive forces between rubber and oil

This way of considering the swelling and solution of rubber has been extended by Dr Gee into a semi-quantitative theory For a given rubber the solvent or swelling powers of a range of liquids will depend upon their C E D relative to that of the rubber An "oil-resisting" rubber is simply one of

Fig 1 — Flexible barrel type coupling

high C E D while the poor petrol resistance of natural rubber is a result of its low C E D The C E D of rubber is unaffected by compounding and the only way to change the C E D of natural rubber is by chemical modification and approximate rules can be drawn up showing the effects of different types of grouping Thus in principle it would be possible to predict roughly the type of structure needed to produce resistance to a given liquid

Radio-isotopes & Rubber

The introduction of artificially produced radio isotopes has already yielded excellent results in many fields of science and rubber research laboratories are also using this new tool Their use as tracers forms the present main application it being possible by the use of active molecules to follow reactions from the start of a process to its finish One such application has been in studies of the vulcanization of rubber by sulphur in efforts to find out the disposition of this vulcanizing agent For this purpose radioactive sulphur is used a practice following that of research in coking processes where radioactive sulphur in the coal makes it possible to determine which part of the sulphur in steel came from the coke and which part from the iron

The addition of radioactive copper is being used to determine the solubility of copper in rubber and it is possible that similar use of radioactive isotopes will be instrumental in settling the vexed question as to the chemical or physical nature of the rubber to metal bond

Bonding

Perhaps the most striking development in the use of rubber in any form of engineering is the evolution of the rubber to metal bond Bonding can be effected by several methods such as cementing adhesives etc but the method most used is that of brass plating bonding in which the metal part is cleaned and given an electro deposit of brass

Fig 2 — Portions of unrubberized (left) and rubberized (right) carpet after an accelerated abrasion test

FIG 3 — SMALL GEAR AND ENGINEERS' SQUARE AND DIVIDERS, COATED WITH VULCANIZED FILM USING A HEAT-SENSITIZED VULCANIZED LATEX CONTAINING SODIUM BENZOATE

Surprisingly, and contrary to common practice, it is unnecessary to have a mechanically rough surface What is important, of course, is to ensure perfect adhesion of the brass to the steel or other metal The rubber, shaped to requirements, can then be moulded, bonded and vulcanized in one operation to the metal

The reasons for the tenacious strength of the bond between the rubber and the metal have been much investigated, but the exact mechanism is not yet fully understood — it may be primarily either physical or chemical, but the main fact is that it functions, and functions extremely well, enabling rubber to be used in shear, which imposes more severe stresses than does compression, thus permitting its flexible and elastic characteristics to be utilized to the fullest extent

"Positex"

Dr C M. Blow has evolved a new form of natural rubber latex known as " Positex " in which the latex has a reversed charge Its action can be stated briefly, surfaces with like charges repel, surfaces with unlike charges attract Textile fibres in contact with alkaline solutions carry a negative charge, the particles of normal rubber latex also carry a negative charge There is thus no mutual attraction In " Positex " the charge of the particles has been reversed to positive, but not by acidification, so that it is possible to have a textile fibre and a rubber particle in the same (alkaline) medium with unlike charges The particles of rubber are attracted to the fibre and deposited thereon This process is already being adopted by textile makers as it lends itself to the production of unique designs on the material

Corrosion Inhibitors

The study of organic inhibitors for corrosion prevention has been carried out at the Welwyn laboratories in conjunction with the Chemical Research Laboratory, D S I R , with particular reference to wrapping materials and for the prevention of rust on stored metal goods, hand tools, etc It has been found that the inclusion of up to 5 per cent sodium benzoate in latex provides a film which prevents oxidation but which can easily be stripped from the article when it is required This development is interesting in that, previous to its discovery, similar "skin" and spray materials, extensively

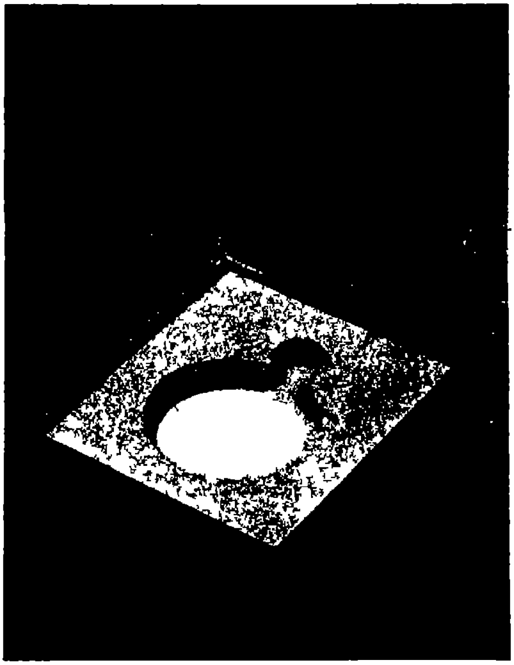

FIG 4 — " RUBAZOTE " SOFT EXPANDED RUBBER WILL AFFORD PROTECTION TO THE MOST DELICATE INSTRUMENT THIS PHOTOGRAPH ILLUSTRATES A WATCH CASE LINED WITH " RUBAZOTE ' PADS CUT AND PUNCHED TO SHAPE

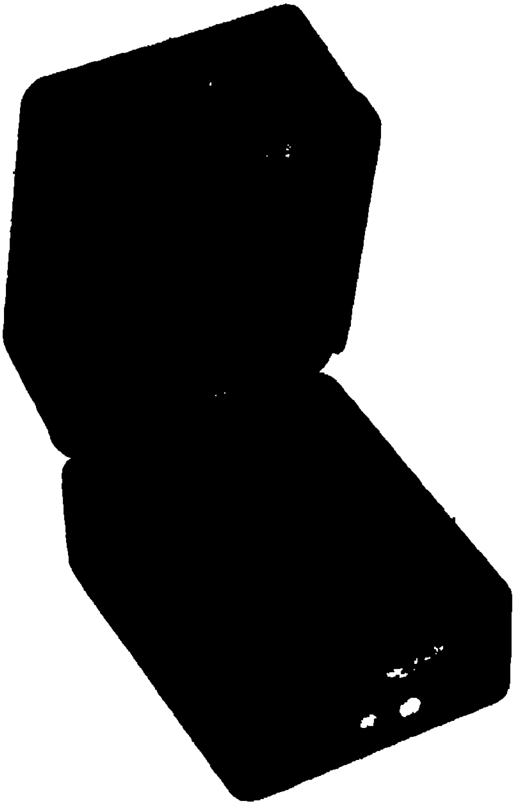

FIG 5 — CONTAINER LINED WITH EXPANDED RUBBER FOR CONVEYANCE OF RADIO VALVES AND SPARES (*Courtesy Expanded Rubber Co Ltd*)

used for protecting service vehicles, etc , had to be purchased from dollar countries.

Conductive Rubber

Rubber specially compounded to act as a heat-providing element is a revolution in rubber usage, in which the conventional insulating properties are reversed This special rubber is supplied in sheets and, by attaching suitable electrical connections to it and enclosing the sheet in conventional insulating rubber, it forms a heating pad. A practical heating element can be made and designs have already been installed for 24 to 28 volts on aircraft, 32 volts for farm and railroad cars, 115 volts for domestic [illegible] and 220 volts for industrial purposes Ceiling heating by means of conductive rubber enables heat to be directed where it is required — the element can be backed with a reflecting sheet of metal foil Research workers will be interested in adapting this type of rubber to their own uses for maintaining steady and constant heat in various items of apparatus — the rubber can be used to give an all-round supply of heat in incubators, and its flexibility enables it to be wrapped around bulbous glass flasks, glass and other supply tubes, etc This is particularly useful where inflammable liquids usually of low boiling point, are in use. *The British Rubber Development Board, Market Buildings, London E C* 3, are able to give advice on the use of this and other types of rubber

To end this brief survey on a lighter note: Van Rossem has carried out work on the phenomenon of light production on elon-

FIG 6 — ANTI-VIBRATION MOUNTING FOR MACHINERY

FIG. 7 — "RUBAZOTE" COVERS FOR AMPOULES PROVIDE NOT ONLY ADEQUATE PROTECTION FOR THE AMPOULE BUT ALSO ENABLES THE CONTENTS TO BE SEEN

gating vulcanised rubbers. If a thin sample of vulcanized rubber is torn in a dark room, it shows light effects. The explanation appears to be that, on elongating vulcanized rubbers containing fillers, the adhesion of rubber-filler particles is broken and electrical charges appear on an extremely large surface, which lead to innumerable discharges into surrounding vacuoles, causing the light phenomenon observed.

High Temperature Alloys for Gas Turbines — Literature Report No. 5

B S SRIKANTIAH & B R NIJHAWAN
National Metallurgical Laboratory, Jamshedpur

THE study of alloys for high temperature service has assumed importance only in recent years. This has, to some extent, followed the developments in gas turbine design, and most of the advance has taken place only after 1939. The earlier types of gas turbine engines failed[1] because too large a percentage of the power developed was required to drive the inefficient compressors. In 1939, however, high efficiency compressors and alloys which could withstand a temperature of 1500°F were developed to overcome this defect.

The useful work obtainable from the gas turbine increases very rapidly as the compressor inlet temperature is decreased and as the turbine initial temperature is increased. As the gas temperature goes up, the amount of air to be handled is progressively smaller. Thus in the gas turbine we have bulky machinery producing little power (since it works at lower temperatures) compared to power plants that are compact, light in weight and of good overall efficiency.

The problem, therefore, in designing a successful gas turbine plant is that of finding suitable materials for operation at the high temperatures required for a thermal efficiency comparable to that of a steam turbine or diesel engine.

The first factor that has to be taken into consideration is the tensile strength of materials which is reduced at high temperature. The second factor is that of creep strength. The phenomenon of creep becomes apparent in prolonged exposure at high temperatures. Creep exhibits itself as a growth or elongation of the material when subjected to load and the rate at which it takes place depends upon the load applied and the temperature.

The important properties to be satisfied by the material for rotor blades are high resistance to oxidation and creep and high fatigue strength at elevated temperatures. Another factor involved is that of working the material at high temperature in manufacturing the blades. This is avoided to a certain extent in the case of parts made by casting.

The Stay-blade Steel

This steel was first used in the Whittle engine. The typical composition of stay-blade steel given by Hall[2] is *C 0* , 22 , Si, 1 , Mn, 0 60 , Cr, 20 0 , Ni, 8 5 and Ti, 1·2 per cent. The normal heat treatment consists in air cooling from 1050°C , followed by a reheating for 1 hr at 800°C from which temperature the material is again cooled. The proof-stress tests show that the proof properties are substantially maintained at a temperature of 500°C and are good at 600°C. The steel has also useful degree of fatigue resistance and at normal temperature has a fatigue resistance of 21·75 tons/sq in.

The creep resistance of this steel has been tested by the " time yield " method. The " time yield " stress is approximately equivalent to a rate of creep of one-millionth of an inch/hr. The specimen placed under the

TABLE I

TEMP., °C.	STRESS tons/sq. in.
400	22 0
450	19 0
500	14 5
550	9 5
600	7 0
700	1 25
800	750 lb./sq. in.

TABLE II

TEMP., °C.	STRESS tons/sq. in.
400	19
500	18
600	15
700	16
800	1 75

TABLE III

TEMP, °C.	C G S. UNITS
100	0 034
200	0 038
300	0 044
400	0 048
500	0 051
600	0 055
700	0 058
800	0 062

TABLE IV

TEMP, °C.	STRESS tons/sq in
400	19
500	12
600	4 5
700	1 75
800	1200
900	280
1000	90

" time yield " stress should not show an extension exceeding 0·5 per cent of the gauge length in the first 24 hr and during the next 48 hr should show no further extension within a sensitivity measurement of 10^{-4} in on a 2-in gauge length

The " time yield " values for stay-blade steel according to Hall are given in Table I

Stay-blade steel is an austenitic steel and possesses a low coefficient of expansion associated with this type of steel

R-Ex 78

This steel is an improvement over the earlier developed stay-blade steel It analyses to C, 0·07, Si, 0·07; Mn, 0·08, Cr, 14·0, Ni, 18·0, Mo, 3 75, W, 3·6 and Ti, 0·65 per cent The normal heat treatment for this is as follows air cooling from 1050°C, soaking for 3 hr at 800°C and air cooling and soaking for 48 hr at 600°C and air cooling The resistance to creep of R-Ex 78 steel on the basis of " time yield " test is given in Table II

The fatigue properties of this steel in the Haigh test on the basis of an endurance of 40 × 10^6 cycles completed in about 300 hr are as follows.

Temp, °C	*Stress tons/sq. in.*
600	12 ± 10
650	12 ± 8 3
700	9 ± 5 7

The density of the steel (8·05/cm ^{3}) is higher than that of stay-blade steel The steel being austenitic has a low thermal coefficient of expansion The thermal conductivity figures for R-Ex 78 steel are given in Table III

H.R. Crown Max Steel

Most of the nozzle blades are produced by precision castings by the " lost wax " process H R. Crown Max steel developed by *Firth Vickers* is extensively used for this purpose A typical analysis of this steel would be C, 0·22, Si, 1·6, Mn, 0·4, Cr, 23·2, Ni, 11·8 and W, 2·9 per cent

The normal heat treatment for this steel consists in air cooling from 1050°C.

The creep resistance according to the " time yield " test is given in Table IV

The density of this material is 7·9 gm /cm ^{3} Its thermal conductivity is of the same order as R-Ex 78 and the coefficient of thermal expansion ranges from 0 000015 (20° to 100°C) to 0·000018 (900°C)

Immaculate 5

This steel which has scale-resisting properties is a 25/20 Cr-Ni steel and has good oxidation resistance up to temperatures of 1100° to 1150°C A typical analysis is C, 0 14, Si, 1 36, Mn, 0 30, Cr, 24·35 and Ni, 21 5 per cent

The normal heat treatment is to air cool from 1050°C The density of Immaculate 5 steel is 7·9 gm /cm ^{3}, and its thermal conductivity is 0·033 C G S units at 15°C and 0·076 C G S units at 1100°C Immaculate 5 is also an austenitic steel and has a low coefficient of expansion

Fleischmann[3,4] has described with a large number of graphs and photomicrographs a patented composition for this new alloy It has been claimed that this alloy has a high creep resistance at elevated temperatures.

Nimonic Alloys[5]

The *Mond Nickel Co* has developed a series of alloys known as " Nimonic " which are nickel-chromium alloys of different compositions These alloys have very good oxidation and corrosion resistance and are used when only a limited amount of creep deformation can be tolerated under steady loads at high operating temperatures

The Nimonic series consist of three alloys Nimonic 75, Nimonic 80 and Nimonic 80A The composition of these alloys falls within these ranges C, 0 to 1 0, Si, 1 to 0, Mn, 1 to 0, Fe, 5·0 to 0, Cr, 19 to 22, Ti, 1·5 to 3·0, Al, 0·5 to 1 5 per cent and the balance Ni Nimonic 75 is used for combustion chamber components in most British aircraft turbines Nimonic 80 and 80A are standard materials for the moving blades in every aircraft turbine in Great Britain on account of their superior creep resistance Certain other important properties of this alloy include high oxidation resistance, high fatigue strength under centrifugal mean stress and, above all, satisfactory service

Nimonic 80 is recommended for service temperatures up to, but not over, 750°C In order to meet high stress-carrying capacity at 750°C and above, Nimonic 80A, which is a variant of Nimonic 80, has been developed

Forging & Heat Treatment

These alloys begin to melt at about 1380°C Nimonic 75 can be forged successfully in the temperature range 1180° to 1230°C Forging can continue down to about 1050°C, but becomes increasingly difficult, requiring heavier equipment

Forging of Nimonic 80A can be satisfactorily performed in the range 1050° to 1150°C Due to the rapidly increasing stiffness of this material below 1000°C, frequent reheating is necessary, and in forging turbine blades it is found preferable to apply only one or, at the most, two blows between reheatings The furnace atmosphere should be oxidizing and any fuel used should have a low sulphur content

The heat treatment of Nimonic 80 and 80A consists of a solution treatment for 8 hr at 1080°C, followed by an ageing treatment for 16 hr at 700°C Air is the preferred furnace atmosphere

The extended period of time at the high solution temperature causes an altered superficial layer having a maximum thickness of 0 008 in This layer should be removed by machining or other means prior to putting the part into service Nimonic 80 and 80A are adversely affected by cold work The following British Patents, 580842, 583841, 583162, 583845, 583212, 583848 and 583793 and their equivalent foreign patents, relate to the Nimonic series of alloys, their processing and to articles and parts made from them

A large number of alloys have also been developed in the U S A for use at high temperatures and the comprehensive test results for these alloys are given in a number of papers by Grant[6-9] and Binder[10]

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Rewards for the Discovery of Uranium Deposits

REWARDS FOR THE DISCOVERY OF URANIUM and beryl ores in India, up to a sum of Rs 10,000, depending upon the importance of the discovery, are announced by the Government of India The new deposits would have to be not less than 100 miles (in case of uranium) and 50 miles (in the case of beryllium) away from the known deposits and should be capable of producing 100 tons of uranium oxide in ore (assaying not less than 0·4 per cent U_3O_8) and 100 tons of beryl (assaying not less than 12 per cent BeO) Details are available in the *Gazette of India*, April 15, 1950.

REVIEWS

Chemical Engineering Plant Design, by Frank C Vilbrandt (McGraw-Hill Book Co Inc, New York), New 3rd Edition

EVERYONE INTERESTED IN THE SUBJECT OF chemical engineering should be familiar with the earlier editions of Vilbrandt's treatise on chemical plant design The latest edition shows many improvements, many points have been revised and extended, and its usefulness has been considerably enhanced

If the theoretical and practical exposition of unit processes is an important aspect of chemical engineering, that of plant design is no less important The student of chemical engineering, as also the executive in the profession, needs to have a proper perspective of the merits or otherwise of the different types of equipment employed in the chemical engineering industry, so that he may select and install the units suited to his particular requirement This purpose is not served by text-books dealing with unit processes The author's treatise meets a real need of the chemical engineering literature

Text-books in engineering cannot be expected to incorporate any radical or spectacular change when they are re-edited and re-issued, for rapid and revolutionary developments are not usual in the engineering industry There may be improvements in presentation of particular topics and new data may have to be incorporated In this considerably large edition, the author has made valuable changes in the treatment of a few topics and brought the data up to date.

The book has been well planned and covers all the aspects of the design of chemical plant, beginning from the design of buildings, foundation, drainage, installation of water, steam and other services, power transmission and air-conditioning The subject of project presentation is exhaustively treated, especially with reference to the processes involved, limiting conditions of operations, raw materials, finished products and market control

There is a useful and enlarged chapter on qualitative and quantitative process flow diagrams for materials, equipment and operations This chapter includes a list of pictorial flow diagrams and references to literature

The chapter on selection of equipment is a complete study of the subject The chapter on pre-construction cost and its estimation has been thoroughly revised The cost data selected are amenable to modern treatment More material is presented in this chapter than in the corresponding chapter of earlier editions, and it is this chapter which has made all the difference between this edition and the preceding ones

Considerable new material has been introduced, especially in the chapter on plant development and pilot plant The new illustrative plant project — cama benzene hexachloride units — which is described in full detail, replaces the ferrous sulphate recovery plant treated in the previous editions

The value of the work is considerably enhanced by the exhaustive and comprehensive lists given at the end of each chapter for collateral reading

The author enjoys considerable reputation and the earlier editions of this work are so well known that it would be superfluous to commend this revised and enlarged edition to chemical engineers It is a valuable addition to chemical engineering literature

G G.R.

Mechanics : Statics and Dynamics, by Merit Scott (McGraw-Hill Book Co. Inc., New York), 1949, pp. xi + 394. Price $ 4 50

HERE WE HAVE A NEW TEXT-BOOK OF mechanics divided into two equal parts, statics from page 1 to page 197 and dynamics from page 199 to page 389, with a common index. New text-books are required from time to time for a variety of reasons: (1) new developments in the subject necessitate new treatment from a fresh point of view, mere revision and alteration of an existing book being found inadequate, e g. a book on optics based on the elastic solid theory becomes outmoded at a time when the electromagnetic theory is the accepted one, (2) different groups of students having different initial equipment and aiming at differing standards require different books, (3) varying tradition in different branches of study makes it necessary for even a common subject to be treated in different ways, e g thermodynamics for students of physics and of chemistry, (4) a new book is written when an author feels he can give a treatment simpler than that in existing text-books or he may be able to take a more comprehensive survey of the subject, and (5) a translation may be made of a successful text in a different language Now, the subject of mechanics to the standard aimed at in the present book has not experienced any drastic changes, nor is there a dearth of text-books on mechanics meant for students of applied mathematics, physics and of engineering The present book is not, of course, a translation Hence we should try to find out if the selection of material or method of presentation show novelty and superiority As compared with the well-known books on the subject by Loney or Lamb or Ramsey, the present book is characterized by greater and more uniform use of the analytical methods of the calculus in preference to geometrical and trigonometrical dodges, by the combination of statics and dynamics into one book and by the uniform illustrations of all portions of the subject by vector treatment as an alternative or complementary process The subject of elasticity is also included in statics, together with a somewhat longer treatment of gravitational attraction and potential The equilibrium or motion of chains is not touched upon, but some discussion of oscillations and stability is included The book does not deal with generalized co-ordinates and the other analytical methods of advanced mechanics. No difference is made between general theory and special examples by difference in size of type as is usual in British books and the exercises at the ends of the chapters are also not quite so numerous The author says that the treatment is designed to enable a student to learn the subject for himself and to serve as a bridge between more elementary and more advanced courses, we may say that the book serves the latter purpose well and the former aim is also attained to a good extent Considering courses of study in India, we may say that the book is useful for engineering students and as a preliminary to more advanced texts for physics and mathematics honours candidates On the whole, the book is a welcome addition to the literature on the subject

T.S.S.

Multi-Enzyme Systems, by Malcolm Dixon (Macmillan & Co, London), 1949, pp 101. Price 7*s* 6*d*

THE BOOK UNDER REVIEW ORIGINATED IN a course of lectures delivered at University College, London The lectures have been printed essentially in the form in which they were delivered, and this fact is reflected in the lucidity with which the subject-matter of the book is developed The genesis of the book also explains the omission of original references, to the research worker at least, the value of the book would have been greatly enhanced by their inclusion

The author takes as his text the words of Sir F G Hopkins "the inter-related activity of highly specific catalysts represents a notable device of nature which has supported during the course of evolution, those dynamic manifestations which characterize living things" The interest in multi-enzyme systems arises from the fact that they achieve an organization not by cellular structural factors but by purely chemical specificity "The specificities of the constituent enzymes are so adjusted that the product formed by each enzyme falls within the specificity range of one of the other enzymes present, which is, therefore, capable of continuing the process and directing the substrate a further step down the right path"

After a few important generalizations on the different possibilities of the functional coupling of enzymes into systems, Dr Dixon enumerates a number of processes brought about by such systems He points out that for life to exist, it is necessary to have a minimum number of enzymes linked together in a system which can both bring about energy-yielding reactions and also transfer and use this energy for other processes. He considers in detail the two kinds of reactions brought about by coupled enzymes, the hydrogen transfer reactions which generate energy, and the phosphate transfer reactions which divert the energy for utilization in processes which need it The last two chapters of the book are devoted to certain methods developed by the author for handling the energy data from hydrogen and phosphate transfer reactions quantitatively The *rH* and *rP* scales which he describes are logarithmic in nature and are applied to determine how hydrogen and phosphate would distribute themselves finally among the various dehydrogenase and phosphorase substrates

Dr Dixon has brought within the covers of this slim volume much important data not available elsewhere All biochemists will feel thankful to Dr Dixon for his illuminating exposition of a subject which is still in the stage of experimentation and for that reason formidably complex The get-up and printing of the book are of the standard that one has come to associate with the Cambridge University Press

P S SARMA

Petroleum Refinery Engineering, by W L Nelson (McGraw-Hill Book Co Inc, New York), 3rd Edition, 1949, pp xi + 830 Price $ 9 00

THIS EXCELLENT PUBLICATION BY A LEADING authority on petroleum technology has always been a standard book of reference to all those interested in the subject of petroleum technology The present edition has been entirely rewritten and revised Parts of the previous edition, particularly chapters on basic chemical engineering such as "Heat and Material Balances" and "Countercurrent Operations" have been deleted, since the author feels that these are dealt with exhaustively in any standard book on general chemical engineering While this has certainly helped to maintain the book in its previous handy form, the average reader may feel it cumbersome to refer to other books on these important aspects of refinery engineering.

The chapter on "Cracking and Other Chemical Processes" in the previous editions has been enlarged into two separate chapters, one on catalytic cracking and another on conventional chemical treatments Several outstanding processes involving the utilization and handling of catalysts have come into prominence in recent years and this volume is of great help if one wants to be up to date with the modern developments in this particular branch Many outstanding chemical operations such as alkylation, isomerization and butane dehydrogenation have been developed on a commercial scale during the recent World War and the author has dealt with these subjects ably

This review will be incomplete without a reference to the very important contributions of Mr Nelson on the subject of "Economics of Design" which appear periodically in the *Oil & Gas Journal* These are of very great assistance not only to a designer but also to the average reader since they enable him to understand and appreciate the complicated petroleum economics with ease

This book is a very useful reference volume to all those connected with petroleum refining industry and should find a place in the libraries of all technical institutions.

T R DORASWAMY

An Introduction to the Gas Turbine, by D G Shepherd (Orient Longmans Ltd., Bombay), 1949, pp xii + 387 Price 24s. net

THE FIELD OF APPLICATION OF GAS TURBINES is increasing daily Their success in aircraft has been spectacular, but prior to this development they were already coming into use in locomotive and in power engineering In the past few years notable researches have also been conducted in the United States of America to develop locomotives driven through gas turbines but fuelled by powdered coal instead of oil Indeed, so impressive has been the success of the gas turbine in many fields that it has been stated that the days of the reciprocating internal combustion engine are numbered Forecasting in this way in the scientific and technical world is particularly hazardous Not many years ago the days of the steam engine were also said to be numbered, but the number appears to be "large" And again, with the advent of atomic energy, many have been bold to prophesy the impending demise of all fuel-driven engines, and especially of power plant This is surely phantasy.

It is true that in the world of science and technology new ideas and inventions may come with great rapidity, but there is seldom evidence of the sudden death of earlier developments The growth of technology in the main is not unlike the organic growth of a tree or of a community, if viewed in the broad perspective of the years

The gas turbine has probably come to stay (at all events for some decades if not centuries), and young engineers and technologists are feeling the need for a competent introduction to this subject The stage has indeed been reached when a thorough understanding of the necessary thermodynamics, fluid dynamics, heat transference principles and combustion in relation to the gas turbine has become imperative in the technical world, and this book is a serious attempt to supply a sound introduction to the subject

In the preface we are told that "the author's efforts since he entered the gas turbine field to equip himself with enough comprehension of its many branches for an intelligent perception of its problems have led him to write this book in the hope that it will help others to a preliminary understanding as well" This is a laudable object, and we think the author has achieved it The chapters of the book are well planned and self-contained The earlier ground covers such subjects as basic thermodynamics, flow of gas, combustion and heat exchange. This is followed by fundamental and practical information on compressors, turbines and gas turbine cycles in separate chapters devoted to these respective subjects At the end of each chapter (throughout the book) we find a comprehensive list of reference to technical papers and literature

Later chapters are devoted to describing existing gas turbine power plant and to probable developments and future applications, while the concluding two chapters deal competently with experimental methods, test equipment, auxiliary equipment and control methods. In appendix IV, typical numerous calculations of a gas turbine cycle and its performance are worked out, a most useful help to the reader in understanding and grasping clearly the principles discussed earlier.

In a word, the book forms an excellent introduction to those wishing to understand gas turbines, and particularly to those who are likely to be concerned with gas turbines in the field of power generation The book is well produced and well illustrated. It is commended wholeheartedly.

S G & J W W

Sound Absorbing Materials, by C Zwikker & C Koston (Elsevier Publishing Co Inc, New York, London), 1949, pp 174 Price $ 3 00

THIS BOOK CONTAINING CONTRIBUTIONS FROM the prominent school of Dutch workers in the field of acoustics, notably Prof Zwikker and his colleagues, forms an extremely important addition to the existing literature in this branch of the subject Its appearance at this stage is opportune inasmuch as it provides a scientific basis to the design and the use of sound-absorbing materials which are important in building auditoria and studios Throughout the book the treatment is rigorous, exhaustive and authoritative It follows analogous methods established for electrical transmission theory The concept of normal acoustical impedance material or combination of the materials, which is now established, finds extensive application Mathematics is freely used, as it must in any book on the subject of acoustics The practical problems that arise in the field of design and use of acoustical materials have constantly been kept in view and graphical representations of the design formulae developed are given

After developing the basic expressions for transmission of sound through infinite media, specific cases dealing with finite medium, impervious medium with internal friction, etc, form the subject-matter of chapter I, an important feature of which is the geometrical representation of the formulae developed Chapter II is devoted to more detailed theoretical considerations of viscous and thermal effects of porous media of which all essential sound-absorbing materials are composed Kirchoff's theory is extended for sound propagation in tubes and pores and its consequences brought out Chapter III discusses the process of sound absorption by homogeneous, porous and elastic layers Phenomena involving acoustical refraction in such cases are explained Measuring techniques are dealt with in chapters IV and V Methods of measurement of the primary physical constants of porous materials such as porosity, air resistance, compression modulus and stiffness, etc, are given in chapter IV Methods of measurement of the normal acoustic impedance and absorption coefficient which are more important properties derived from the primary constants are given in chapter V Chapter VI deals with the experiments conducted with artificial samples to substantiate the theoretical derivations of formulae correlating the primary physical constants of actual materials with their acoustical properties The outstanding chapter in the book is chapter VII, dealing with the problem of sound absorption by resonance methods which are widely adopted nowadays for low-frequency absorption in sound-reproducing studios The widely used methods of perforated panelling, backed with absorbing materials, illustrate the applications Problems of oblique incidence of sound find place in chapter VIII and the last chapter of the book These introduce further complications in the theoretical analysis as well as in experimental techniques

There is a wealth of information concentrated in some 170 pages of this book which demands serious study It is a vital book for any one who undertakes to design a good auditorium The authors' claim in this respect is certainly very modest The book should find a place on the shelf of every acoustical engineer

N B B

The Handbook of Textile Industry (Bureau of Economic Research, P O Box No 45, Kanpur), 1949, pp xvi + 429 Price Rs 15

"THE HANDBOOK OF TEXTILE INDUSTRY", 1949, published by the Bureau of Economic Research, Kanpur, is easily the best compilation of useful information concerning the important branches of the textile industry in India It should prove a valuable reference book for all those engaged in different branches of the textile industry — the students, mill managers, management, cotton and other raw material dealers, stores suppliers and yarn and cloth merchants The information collected is well arranged and analysed and would prove quite handy for ready reference

The section concerning the "cotton textile industry" is quite comprehensive and no useful information is omitted The statistical data may have, however, been presented in the form of charts, graphs, etc, in addition to the tables The information under the handloom industry and woollen and jute industry need elaboration A comprehensive review of the position of these branches may usefully be added with details concerning different States

Now that India is a single unit, serious attempt has to be made to build up a well-organized comprehensive economy of each branch of the textile industry with due reference to the economy of the country as a whole Any study of the industry on a regional basis should be such as to utilize all its resources, men and material so as to contribute to a sound economic structure for India It is hoped that in future editions greater emphasis will be placed on this aspect while collecting and analysing the data concerning each branch of the industry

Under the caption "review of the working results of mills", extracts of balance-sheets of a few of the mills in India are published It would be useful to select a group of representative types of mills — small medium and big, also coarse medium and fine, spinning weaving and combined spinning and weaving, preferably on a regional basis, and review their working Such a review would prove very helpful to appreciate the regional problems and factors that affect the industry

There is greater need today than ever before for accurate information concerning an industry It is hoped that the Bureau of Economic Research, Kanpur, will continue to serve the industry

B K MURTHY

The Indian Handloom Weaving Industry Annual 1949, by M P Gandhi (Gandhi & Co), 1949, pp 67 Price Rs 1/8

SRI M P GANDHI'S ANNUAL FOR 1949 contains few new features compared with his previous publication on the subject Sri Gandhi mainly conforms to the method of compiling all the available reports of committees, official orders and statements issued during a period Their reference value is at once recognized in so far as one can readily get information on the subject without having to search for it in different publications

In a publication of this type a critical review of the industry and the work of the committees specially appointed for the purpose by competent experts who have special first hand knowledge of the industry would be useful Generalizations with no reference to the specific problems may not serve much practical purpose

The handloom weaving industry in India is by far the biggest cottage and small scale industry Its economic importance is well recognized for many years Central provincial and state governments have often expressed their anxiety to improve the lot of those engaged in the industry and have been spending large sums of money year to year And yet we are no where nearer to find a satisfactory solution to the several of the problems that face the industry One inference at least seems irresistible i e our method of approach needs improvement For years the Government is constituting committees to report which had the immediate effect of putting off the problems In composing the committees the Government select and nominate men eminent no doubt in their own fields but not fully qualified to consider the problems of the specialized industry by their personal knowledge of the industry The net result has been the publication of a different approach may produce better results I suggest that a committee of technical men who are actively engaged in the organization of the handloom weaving industry charged with the responsibility of finding a practicable scheme that they may work and assure results are more likely to evolve a plan of action than a committee composed of the directors of industries of the governments have been able to do The Central Government may set up an able central committee to co ordinate the efforts of the different units so that each unit be benefited by the experiences of other units In my view there ought to be a frank discussion of experts of different provinces and states and exchange of notes In conferences now held reports of achievements are narrated It is time that discussions on failures find their proper places The problems should be tackled with the scientific spirit of a research worker and all the available experiences of the workers properly co-ordinated for the good of the industry

B K N

Fundamentals of Synthetic Polymer Technology, by P Houwink (Elsevier Publishing Co Inc New York London Amsterdam Brussels) 1949 pp xii + 258 Price $ 4 75

THIS COMPACT AND TERSELY WRITTEN excellent little monograph on high polymers will prove to be a boon to the more advanced student and to the research worker in particular whose ambition is not merely to pursue what may be termed routine research along trodden lines but to open out new and unsuspected lines of research based on original and independent thinking Successful pursuit of fruitful research in this fascinating field will become possible only when one possesses a clear understanding and a thorough grasp of the fundamental chemical and physical principles underlying the processing and technology of the wide array of known high polymers Without mastery of the theoretical background an investigator may perhaps chance to stumble upon an important invention by good luck but can never proceed deliberately to produce something to order To acquire the necessary theoretical knowledge one has normally to go down to the original sources which are available in the form of the large number of valuable research papers continually appearing in a variety of scientific and technical journals This however usually turns out to be a task too difficult even to the most industrious student A number of books are no doubt available and are continually swelling the world s literature on plastics but it is often found that the method of treatment adopted in them is neither critical nor thought provoking but is usually in the form of a rigmarole following the beaten track with little emphasis on the underlying basic principles

Fundamentals of Synthetic Polymer Technology by R Houwink is one of the very few books which stand out in sharp and relieving contrast from most others on the subject and is on a markedly higher scientific level The author has carefully sifted the voluminous technical information available in scientific periodicals and has presented only the essential facts theories and details in a precise trenchant manner omitting all verbose descriptions The reader is never confronted in this book with ambiguous statements or vague and loose expressions which are apt to leave him in doubt The presentation throughout is such that it powerfully exercises the thinking faculties of an intelligent research investigator The book gives in a nutshell and in rigorous scientific diction all that is essential to enable a research worker to chalk out original lines of investigation It is one of the most systematically written books published presenting the research trends and methods prevalent in the three chief centres of polymer research viz America Great Britain and Europe The distinctive feature of this publication lies in the clarity of presentation and the direct approach which has been adopted by the author which give to the reader a thorough grasp of the subject It will be no exaggeration to state that the book will remain a companion of inestimable value to the research worker It may as well be prescribed as a text book for those specializing in this branch The style is remarkably simple easy and convincing and enables one to gain a real insight into the intricacies of the subject

Without appearing to draw invidious distinctions between the different chapters it will be difficult to make particular mention of any one chapter for all of them are equally important yet the first three chapters merit special mention as the most interesting useful and thought provoking

In chapter I dealing with the chemistry of polymers the principles underlying addition polymerization and condensation polymerization the start reaction the growth of the chain and the stop reaction the polymerization rate the role of inhibitors and molecular weight the mechanism of solution and emulsion polymerizations the formation of copolymers the irregularities in the polymer molecules and their significance the main considerations involved in the building of chain globular and net macromolecules etc are elucidated The formation of macromolecules from derivatives of natural substances and the entirely synthetic materials based on ethylene isobutylene phenol formaldehyde glycerine phthalates butadiene superpolyamides silicones etc is briefly referred to in this chapter but dealt with at greater length in succeeding chapters

In chapter II are explained the intermolecular and intramolecular bonds the nature of the binding energy and the forces of dispersion and mutual interactions arising from the different bonds

Chapter III deals with the physics and colloid chemistry of polymers The mechanical properties thermal behaviour solubility and swelling the properties in solution softening and plasticizing optical and X ray behaviour electrical properties permeability etc are defined and discussed but these are not mere prosaic definitions or descriptive accounts of testing methods they place before the reader a picture of the configurations of atoms and chains and the forces that tend to operate which result in giving different high polymers their characteristic properties The connection between the structure of the molecules and micelle and the mechanical thermal electrical and other properties and the influence of the chain character length flexibility orientation etc upon the ultimate behaviour of the materials are clearly and simply elucidated It is this type of treatment which is most profitable to the research worker who has to plan his investigations in order to produce materials of desired characteristics The different methods of the determination of molecular weights and their merits and drawbacks are also explained

In chapter IV dealing with the testing and standardization of plastics the situation obtaining in different countries is briefly reviewed References are made to the specifications adopted in different countries Elaborate descriptions are avoided in this chapter and rightly so since these can be had easily from other sources All the properties and tests are classified under seven groups viz mechanical thermal electrical optical ageing chemical and miscellaneous Due emphasis has been laid on the more systematic and thorough manner in which the test procedures and the specifications are laid down in Germany The author has also referred to the attempts made in Germany to conduct micro tests on the final products rather than on separate test specimens moulded for the purpose the chief justification being that the test results of the moulded specimens do not always check with the actual physical and mechanical properties of the materials in their final form and size in which they are actually employed The author has laid stress on a more detailed study of this aspect which it merits. The author points out that as a rule the standardization and testing methods in Germany reached a high level of perfection and rigorousness which resulted in making their specifications lively contributions to the industry The same cannot be said of other countries, excepting Holland and France to a certain extent

In chapters V to XI, the processing of polymers is briefly described with reference to polymers based on ethylene and its derivatives, the synthetic rubbers, those based on phenol and aniline, those based on carbamides, carboxylic acids and cellulose Laminated products and protective coatings as well as moulded products are mentioned at relevant places in these chapters

In chapter XII polymers based on proteins are described, with particular citation of casein plastics and casein fibres Reference is made to the work of Carothers which led to the development of nylons One would have liked a little more detailed treatment of the other proteins, even if that would have necessitated some curtailment of the paragraphs devoted to the well-known casein plastics

Chapters XIII and XIV are devoted to polymers based on natural rubber and silicone polymers In chapter XV a brief mention is made of polymers derived from natural resins, including shellac, and polyterpene and coumarone-indene resins A slightly more detailed treatment of these topics would have been highly welcome, as that would help a research worker to chalk out lines of research which would bring out the best that these natural materials are capable of

The last chapter, the XVIth, deals with certain economic aspects which, it must be admitted, is something of an innovation in a book of this high scientific level The brief data given in the few tables are highly informative and revealing of the potentialities of some of the materials

The book is very well got-up The same may be said of the illustrations which are most judiciously selected to the extent that they will be of help towards a clear understanding of the subject-matter presented in the book There is no doubt that this book will be a friend, philosopher and guide to any worker interested in research on plastics. It stands out as a signal contribution of the Elsevier Publishing House in that the publishers have found out the right man for the right job

A J R

Principles of Electricity, by Page & Adams (Macmillan & Co, London), Second Edition, 1949, pp 101 Price 7/6s net

THIS WELL-KNOWN BOOK HAS BEEN IN USE as a text-book in the undergraduate classes of many universities The fourteen reprintings it has gone through is good evidence of its popularity The book is well written and is of much use both for teachers and students It is possible to disagree with the 'authors' point of view as far as the presentation is concerned The authors have adopted the electron theory of matter from the beginning It may be pointed out that any exposition which presents factual material first and brings in a theory only later to account for known facts would be better from a philosophical point of view The exposition must aim at distinguishing between our experience on the one hand and our concepts (however justifiable their construction may be) on the other Such an account would render it easy for a student to examine critically the measure of success attendant on any theory and suggest, if possible, improvements, modifications or alternatives This remark, however, is not intended to minimize the importance of the book It has been called an "intermediate text" and it serves this purpose very well both for the undergraduate and the advanced student The addition of new material of contemporary importance like the cyclotron, the betatron and the wave guide in this new edition is very welcome. The reviewer has no hesitation in warmly recommending the book to those engaged in the universities

D S SUBBA RAMAIYA

The Swelling of Wood under Stress, by W W Barkas (His Majesty's Stationery Office, London), 1949, pp iv + 103 + symbols at the end of the book Price 6s

THIS BOOK IS BASED ON A COURSE OF LECTURES delivered at Svenska Traforsknings-institute Stockholm, Sweden, in 1948 The author's work on the calculation of the swelling pressures and elastic constants of gel structures from their moisture absorbing properties conducted in the Physics Section of the Forest Products Research Laboratory is an important and notable contribution This was already published by the Department of Scientific & Industrial Research Great Britain in their special report No 6 entitled *Swelling Stresses in Gels* The present book under review is an elaboration of the same and includes illuminating discussions of other closely allied topics

Although the author s treatment of the subject is descriptive and diagrammatic it is at the same time sufficiently mathematical to enable an exact appreciation of the forces which are usually operative in the swelling of natural organic structures such as wood in particular The argument and the rationale developed in this book with special reference to wood may with great advantage be also extended to studies of other important substances of a complex nature such as cotton silk wool and other keratins in general The conception of instantaneous elasticity introduced in these discussions allows the thermodynamic method to be applied accurately to solids which like wood are partially plastic The author s main theme is to establish the relations between the hygroscopic and elastic properties of cellulosic materials whereby the former may be used to calculate the latter

The author has rightly emphasized that the basis of research is or should be complete scepticism especially in studies of fundamental problems of applied research where one has to deal with real materials and not with theoretical mental abstractions The author has taken this as a guiding principle in all his discussions and has from time to time brought to the notice of the reader discrepancies and shortcomings which are inevitable in a too facile application of accepted physical theories to real substances with all their natural diversities of structure and attendant complexity of the factors involved in their studies

The book is divided into five main chapters Chapter I deals with the structure of wood sorption and swelling In chapter II anisotropic elasticity is discussed at great length Chapter III deals with the swelling stresses in elastic gels The implications of *varying* swelling stresses under changing conditions of humidity on the elastic properties of gels are fully brought out In chapter IV the concept of plasticity with special reference to cellulosic materials is elucidated Chapter V which is the most interesting deals with sorption hysteresis which one usually notices in a number of other natural substances such as proteins viz horn and wool fibres and inorganic materials such as silica and other gels

Emphasis is laid on certain general considerations which were not appreciated adequately by earlier workers viz that the essential property which distinguishes gels from solutions is their rigidity that hydrostatic pressures alone do not constitute swelling pressures that the swelling pressure equation

$$P = -\frac{RT}{M\mu}\log H$$

involving merely the properties of the swelling liquid and ignoring those of the gel substance itself must be necessarily inadequate that the swelling pressure of a gel held at constant moisture content is not the same as that when at constant volume etc Generalized expressions relating the swelling pressure to the bulk modulus the Young s modulus the Poisson s ratio and the rigidity modulus are derived by having recourse to a thermodynamic approach and applying the same to the case of an idealized gel Application of these generalizations to the case of natural fibrous materials has serious limitations on account of the extreme anisotropy and also on account of their divergence in behaviour from the purely elastic type assumed for an idealized gel The author draws the reader s attention to these limitations and suggests approximate mathematical solutions for such cases

The book is characterized by a clear analysis and rigorous reasoning which will be highly edifying to investigators who are endowed with an original bent of mind and equipped with fairly advanced knowledge of mathematics as applied to the properties of matter Even more than the calculations and subject matter presented in this book the rigidly and unsparingly scientific approach so keenly evidenced in every line of it is highly educative to students launching upon a research career and no less to established scientists who are sometimes known to make a mark by their chance discoveries favoured by fortuitous circumstances

A J R

Non-Technical Notes

THE MANUFACTURE OF GELATINE FROM HIDES & SKINS

GELATINE AND GLUE HAVE AN IMPORTANT place in industry Gelatine is used as a coating on photographic films and plates as a material used for edible purposes as a receptacle for medicines in pharmaceutical work and for several other purposes while glue is used as a cheap adhesive

The raw materials for the manufacture of gelatine and glue are bones hides and skins India produces about 20 million hides and 40 million skins per year The country s leather industry is concentrated in relatively few centres and processes close upon 3 million skins and hides per year In normal operations 5 to 10 per cent of the material is obtained as trimmings and cuttings and these form the potential raw material for the manufacture of gelatine and glue

The utilization of the waste materials of the leather industry for the manufacture of glue is an established industry in India but attempts at the manufacture of gelatine from these materials do not appear to have been successful until now As a result of extensive investigations carried out under the auspices of the Council of Scientific & Industrial Research a method has been worked out for the manufacture of gelatine — both the photographic and ordinary qualities — from hides and skins

By this process gelatine can be extracted from skin and hide trimmings to the extent of 18 per cent A small percentage of glue also about 5 to 6 per cent can be extracted by further processing and the final residue can be used as a cheap manure

The process consists essentially of the following steps

1 Liming of hide and skin cuttings in lime pits for an extended period

2 Removal of hair and epidermis from the limed cuttings

3 Deliming and washing of swollen cuttings

4 Extraction of gelatine from delimed cuttings

5 Filtration and bleaching of the aqueous extract

6 Chemical treatment of the aqueous extract to improve the properties of the final product

7 Concentration of the aqueous extract by evaporation

8 Cooling the concentrated solution to obtain the solid product

Each of these processes requires careful control of operating conditions such as the period of liming *p*H temperature and time of extraction temperature and degree of evaporation and temperature and purity of the air used for cooling and drying etc

Estimates of initial outlay and the cost of manufacture for a daily production of 1 100 lb of gelatine are given below

CAPITAL EXPENDITURE

	Rs
1 *Land & Building* —	
Land (18 000 sq ft) (Expenditure on this item depends on the locality where the factory is situated)	
Building and sheds	1 50 000
2 *Machinery & Equipment* —	
Washing equipment	6 000
Extraction equipment	40 000
Evaporation equipment	55 000
Refrigeration	60 000
Filter press and auxiliaries	12 000
Drying chamber equipment	7 000
Boiler and auxiliaries	50 000
Laboratory equipment etc	15 000
Erection and other expenses	35 000
	2 80 000
3 *Working Capital (To cover three month s operating costs)*	60 000
Initial investment (excluding the cost of land)	4 90 000

(If we provide Rs 10 000 towards the cost of land the total investment required will be Rs 5 00 000)

Cost of manufacture of 1 100 lb of gelatine per day

	Rs	as	p
Raw hide and skin trimmings 2 85 tons @ Rs 350 per ton	997	8	0
Lime 0 67 ton @ Rs 100 per ton	67	0	0
Other chemicals	90	4	0
	1154	12	0

	Rs.	as.	p.
Steam 32,000 lb @ Rs 6 per 1,000 lb	192	0	0
Power 162 kWt @ -/1/- per kW	10	2	0
Water 10,000 gallons @ Re 1 per 1,000 gallons	10	0	0
Direct labour and supervision charges	316	0	0
Maintenance and repairs	20	0	0
	1702	14	0
Overheads —			
Interest on initial investments of 5,00,000 @ 6 % spread over 300 days	100	0	0
Depreciation on plant equipment 2,80,000 @ 15 % spread over 300 days	140	0	0
Depreciation on building, 1,50,000 @ 5 % spread over 300 days	25	0	0
Other overheads (rents, rates, taxes, works and office overheads, etc)	30	0	0
Total cost of production of 1,100 lb of gelatine	1,997	14	0
Average cost of production per lb of gelatine	1	13	0

In addition to 1,100 lb of gelatine, the cost estimates for the production of which are given above, about 125 lb of glue and 2 tons of manure are also obtained in this process

Hon'ble Sri Harekrishna Mahtab

THE Council of Scientific & Industrial Research extends a hearty welcome to its new Vice-President, the Hon'ble Sri Harekrishna Mahtab, ex-Premier of Orissa, now Minister of Industry and Supply in the Government of India

Born on 21st November 1899, in the village Agarpara of Balasore district in Orissa, and brought up in a puritanic way of life, Sri Mahtab was profoundly influenced by the non-co-operation movement of Mahatma Gandhi He gave up his studies at the Ravenshaw College, Cuttack, sacrificed the prospect of an easy life as the proprietor of a rich estate, and plunged himself wholeheartedly into the national struggle. Ever since 1920 he has been the central figure of all forward politics in the province

He was instrumental in rescuing the politics of Orissa from the moorings of narrow provincialism and broad-basing it on Indian nationalism It was mainly through his efforts that the Congress Organization in Orissa was put on a sound basis

Sri Mahtab formed the Orissa Cabinet as Premier in April 1946 The most outstanding achievement of his Ministry has been the merger of the Orissa States in the province, and he is rightly called the Maker of Greater Orissa The fructification of the Mahanady Valley Project is due to his efforts both in the State and at the Centre.

HON'BLE SRI HAREKRISHNA MAHTAB, MINISTER FOR INDUSTRY & SUPPLY, AND VICE-PRESIDENT, COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

Sri Mahtab is a novelist, historian, poet and dramatist. He is the founder of *Prajatantra* (Oriya daily), the *Eastern Times* and the *Jhankar* (literary monthly of Orissa). His *History of Orissa* in Oriya and in English is an authoritative work. He is the author of many novels, dramas and poems

Fluorocarbons[*]

M M SINGH
National Chemical Laboratory Poona

FLUORINE though prepared first in 1886 by Moissan[1] did not attract much attention for a number of years During World War II however the progress of fluorine chemistry was rapid This was mainly due to its bearing on the development of atomic energy Materials of construction which were chemically inert were required The fluorocarbons were recommended and they proved their merit

Fluorocarbons are compounds of carbon and fluorine only In general they represent compounds of carbon analogous to hydrocarbons in which fluorine instead of hydrogen is attached to the carbon Fluorocarbons containing from one to some twenty carbon atoms have already been prepared A wide variety of structures including unbranched and branched chain aliphatic types single and fused cyclic structures and combinations of these are known to be possible Such materials range from gases like CF_4 through volatile liquids and high boiling oils to crystalline solids

Preparation

The fluorocarbons were first prepared by a direct reaction between carbon and gaseous fluorine The reaction was somewhat hazardous due to explosions Later on however the reaction was controlled by means of suitable catalysts The technique for catalytic fluorination has been developed and improved to such an extent that a desired saturated fluorocarbon may be now produced by the reaction of the corresponding hydrocarbon vapour and fluorine Both are diluted by nitrogen and gradually mixed in the presence of fine copper turnings or ribbon coated with a thin layer of silver fluoride

Burford[2] and co workers have described in some detail the design construction and operation of a pilot plant for production of fluorocarbons by the CoF_3 process

Organic chemicals on direct reaction with hydrofluoric acid produce fluorocarbons and certain of their derivatives in a one step electrochemical process This process is carried out at a low temperature and does not produce or employ elementary fluorine Fluorocarbons of a great variety of structures have been produced by this process

The preparation of a series of saturated fused ring fluorocarbons are described by McBee and Bechtol[3] These compounds are prepared in general by fluorination of the corresponding aromatic hydrocarbons with silver fluoride

The first fluorine-containing polymer to reach commercial production was polytetrafluoroethylene[4] — named Teflon The polymerization was carried out in the presence of sulphur dioxide Various copolymers of tetrafluoroethylene chloro trifluoroethylene and vinyl fluoride have been prepared

It has been found possible to obtain fluoro derivatives of hydrocarbons or halogenated hydrocarbons by the action of HF upon the corresponding bromo or iodo derivatives in the presence of HgO using the method of Henne[5]

Properties

Fluorocarbons in general are dense colourless liquids with a faint and unpleasant odour They have abnormally low refractive indices and surface tensions while their boiling points and freezing points are not widely different from those of parent hydrocarbons The boiling points are extremely low relative to the molecular weights coming closer in this respect to inert gases than to any other type of chemical compounds

They have relatively high fluidities The liquid densities are between 50 and 100 per cent greater than the corresponding hydrocarbons

Compared to hydrocarbons they are completely resistant to oxidation and do not burn They resist the action of most chemical reagents — even alkali metals —up to a relatively high temperature

Utilisation

Fluorocarbons find a wide application in industry on account of their non flammability and extreme stability to heat and chemical reagents[6]

Teflon the fluorocarbon plastic is a product of considerable interest It has been applied successfully in the generation and handling of fluorine gas Development of new techniques for fabricating the polymer have progressed a good deal A coating of the plastic will help to save the metal equipment against corrosion

Chlorofluorocarbons on polymerization give highly stable oils greases and waxes Practical synthetic methods for the production of these fluorocarbon type oils and greases to be used as lubricants (known as fluorolubes) have been developed Chlorotrifluoroethylene has been polymerized in the desired range of molecular weights These fluorolubes find application as heat transfer media and dielectric media It should now be possible to develop new types of engines to operate at high temperature with fluorolubes

Copolymers from tetrafluoroethylene chlorotrifluoroethylene and vinyl fluoride have relatively high softening temperatures These properties make them desirable for use as a base in photographic and X ray films as well as in coating compositions and fibres

The unique properties of many fluorocarbons as solvents make these compounds suitable for special operations in the field of solvent extractions

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[*] Invited article

It is indicated that because of their special specific properties fluorocarbons will find use as heat transfer and dielectric media fire extinguishers turbine impellents high temperature lubricants refrigerants seal liquids etc

In addition fluorocarbons offer great possibilities in the study of many theoretical problems They are important tools for studies of molecular forces and structure of carbon compounds Comparison of their properties with those of the corresponding hydrocarbons may shed light on the nature of the hydrocarbons and their C C linkage Because the mass of the F atom is closer to the mass of the C atom than that of H atom more complete patterns it is hoped will be found for all the distances and angles in the structure of fluorocarbons and hydrocarbons

In addition to the fluorocarbons compounds are also obtained in which the major constituents are C and F but in which there are other minor constituents like H O Cl etc The production of fluorocarbons containing these other elements greatly increases the number of types of compounds produced and thus also widens the range of possible uses of fluorocarbons On the basis of information now available it may be stated without exaggeration that in the study of fluorocarbons we are confronted with a vast new field of inorganic organic chemistry which is as immense as organic chemistry

REFERENCES

1 Moissan *Compt Rend* 1886 **102** 1543 1886 **103** 202 256
2 Burford *Ind Eng Chem* 1947 **39** 319
3 McBee & Bechtol ibid 1947 **39** 380
4 Idem ibid 1946 **38** 870
5 Henne *Report No Br* 177 (Declassified)
6 Gross A V *S A M Labs Rept* July 1942 15

Refractories Division, National Metallurgical Laboratory

The Refractories Division of the National Metallurgical Laboratory has the following functions assigned to it (1) Investigation of raw materials (a) to assess the refractory value properties and possible uses of raw materials available in the country (b) to establish methods for standardization and quality control of refractory raw materials and (c) to assess the relationship between composition and working properties of refractory materials (2) Development of new materials and processes (a) to develop refractory materials not at present being produced in the country (b) to improve the quality of products fabricated in the country (c) to develop special materials and products required for high temperature metallurgical research and (d) to assist in the development of manufacturing processes of refractory materials (3) Investigation into the performance of refractory materials and improvement of test methods (a) to collaborate with the *ISI* in developing standards for indigenous refractories (4) Fundamental research in refractories (a) constitution of refractory products by X ray and photographic methods (b) physical characteristics of refractories at elevated temperatures and (c) phase reactions of certain refractory systems

Facilities are available in the Division for processing new compositions on a pilot plant scale Equipment required for handling 225 lb to 250 lb batches from the lumpy mineral stage to the ultimate stage of a fired product has been installed With facilities available in the other Divisions of the Laboratory a complete range of tools for applied and fundamental research in refractories will be available

NOTES & NEWS

Argemone Oil Alkaloids

A METHOD BY WHICH THE ALKAloids of argemone oil can be easily eleminated from mustard oil adulterated with it, keeping the edible properties of the mustard oil unimpaired, has been worked out at the *Provincial Industrial Research Laboratory*, Patna (*Curr Sci*, 1950, 19, 91)

Treatment of the adulterated mustard oil with pure phosphoric acid, the amount varying according to the percentage of adulteration with the argemone oil (about 1 to 1 5 per cent of phosphoric acid for 10 per cent adulteration was found satisfactory) at the ordinary temperature removed practically the whole of the alkaloids as insoluble phosphates together with the little albuminoids and colouring matter of the original oil Traces of alkaloids still remaining in the oil could be completely removed by shaking this acid-treated oil with about 2 per cent of acid-activated Fuller's earth and filtering it through a filter press

Excess of phosphoric acid in the oil was finally neutralized by the addition of a requisite amount of precipitate chalk and filtering the oil again through the filter press

The characteristics as well as other physical properties of this treated oil differed little from those of the pure mustard oil excepting that a slight fading of colour and odour and a little reduction in specific gravity were noticed

Identification of Alkaloids

THE USUAL STEPHENSON'S CRYSTAL test for identifying alkaloids is applicable only when quantities of the order of 50 μ gm. are available A method is described for rapid examination of alkaloids in low concentrations (*Canad J. Res*, 1950, 28, 37)

Slides containing double depressions are employed A small drop of the drug solution is placed in one of the depressions and to it is added a small drop of reagent The total quantity is such that the depression is about two-thirds filled by the drop Spontaneous evaporation is permitted or the slide may be put under a fan Concentration takes place more rapidly at the surface and the outer edges The outer edge is examined frequently, when spontaneous evaporation is allowed, the slide may rest on the microscope platform If crystals occur early characteristic ones will soon form on the edge and either grow inwards or along the edge The slide must be rotated and the whole perimeter of the drop examined, for it seems, possibly owing to the uneven mixing that the crystals occur more readily in one spot than in another on the edge Examination must be made very frequently in such instances as that of identifying morphine with Marme's reagent, abundant crystals of the reagent may appear early and obscure the small crystals of morphine A distinct advantage of using the slides having the depression for crystal tests is that photomicrographs may be made of the crystals on the slide under the microscope and a permanent record preserved for future reference

When the reagent used is known, the alkaloid present can be readily identified by a glance through the microscope at the crystals on the edge or by examination of the photomicrograph The satisfactory reagent for crystallization is found by experimentation The presence of sulphuric phosphoric, hydrobromic or hydrochloric acid up to 25 per cent by volume may greatly assist in the formation of characteristic crystals when gold or platinum solutions are used as reagents

Double Superphosphate Process

THE DEVELOPMENT OF THE double superphosphate and wet phosphoric acid processes is reviewed and the manufacture of double superphosphates in modern plants is described (*Acta Polytechnica*, 46, 1949)

This process differs from the ordinary superphosphate process in the mixing period is shorter, solidification sets in more rapidly, seasoning period is longer, calcium sulphate is not formed, a lesser quantity of gases is evolved and less heat is developed The two principal factors affecting the costs are the need for finer grinding of the phosphate used to quicken the seasoning process and the production of concentrated phosphoric acid Regarding the former it is suggested that if the double superphosphate produced were dried after the production, the need for fine grinding of the phosphate used would be lessened Regarding phosphoric acid it is indicated that if the acid made from phosphate and sulphuric acid was concentrated to about 50 per cent P_2O_5, a normal product could be produced at a reasonable cost If the phosphoric acid used is produced according to the wet process and is to be concentrated to about 50 per cent P_2O_5 it might he better to use it in its original, more diluted form and to remove the surplus of water by drying the double superphosphate This could be done as follows a comparatively large quantity of double superphosphate is returned to the process in the form of small granules The phosphoric acid with 30 to 35 per cent P_2O_5 is reacted with a corresponding quantity of phosphate and the sludge thus formed is mixed with the granules, covering them with a thin coating of sludge The moistened granules are then dried preferably with combustion gases in a rotating drum, the dried granules screened and a small fraction taken away as product About 80 to 90 per cent is returned to the process, the oversize particles having been crushed The double superphosphate plant belonging to the *Southern Acid & Sulphur Co*, Houston, Texas, and built by the Dorr Company, is run on this process A similar process that enables the production of an acid with a P_2O_5 content of between 45 and 48 per cent has been developed The acid is sprinkled into a granulator working intermittently or continuously, the granulator being fed with ground phosphate and crushed over-sized particles Granules are formed rapidly and heat is evolved so that very little heating is required in the dryer Granular double superphosphate can be manufactured by this process in any superphosphate granulating plant of normal design without the trouble of making pulverized double superphosphate at an earlier stage

Investigations on the wet phosphoric acid process were undertaken to determine a suitable method of making a comparatively strong phosphoric acid which when mixed with the sulphuric acid in suitable proportions would give a high percentage of plant available P_2O_5 in the superphosphate The process could be performed according to 3 different methods depending on the form of calcium sulphate left in the sludge In order to make a relatively strong phosphoric acid without evaporation and at the same time to be able to obtain as high a yield as possible it is essential to (i) make a good filtrable sludge after the disruption of phosphate with sulphuric acid and (ii) to employ suitable filters To achieve this the reaction is to be conducted in such a way that the calcium sulphate will form (a) stable crystals and (b) large crystals (or agglomerated crystals) This depends mainly on the concentration of phosphoric acid in the sludge and the reaction temperature

Manufacture of Activated Carbon

A NEW METHOD OF PRODUCING activated carbon employing hydrochloric acid gas and the oxychloride of an alkaline earth as an activator has recently been patented (*British Patent No* 630 886 *Industrial Chemist* 1950 **26**, 39)

The carbonaceous material is intimately mixed with magnesia which is obtained by calcining the carbonate hydroxide nitrate or an organic salt of magnesium at a temperature below 800°C Sufficient magnesium chloride solution of 27° to 32° Bé is then added to the mixture so as to form a firm dough

The dough is next flattened to a slab of convenient thickness which is dried in the air from 1 to 3 hr subdivided and allowed to set On a large scale bricks may be formed in a clay pug mill of the extrusion type while in the laboratory the small blocks are heated to between 650°C in a crucible having one escape vent for vapours in the lid

After heating the blocks or bricks are crushed to powder extracted with hydrochloric acid solution filtered and washed free from salt solutions and hydrochloric acid with water The material is finally treated with dilute ammonia to neutralize residual acidity Traces of ammonia are removed by drying below 100 C leaving a carbon with high powers of decolourization and gas absorption

Anti corrosive Pigments

STUDIES CONDUCTED ON ALKAline earth plumbates for their utility as anti corrosive pigments are reported (*Chem Trade J* 1950 **126**, 437)

Alkaline earth pigments were prepared by heating intimate mixtures of litharge and lime and strontium and barium carbonates in proportions of one mole of lead oxide to two moles of the base under controlled conditions the rate of oxidation being followed by periodic determination of the lead peroxide content Of all the plumbates the calcium compound exhibited the widest range in colour variations depending upon very small variations in the properties of lime and lead oxide and in the mixtures from which it was prepared Calcium plumbate required little grinding after treatment in a furnace and although the lead content was higher than that of either strontium or barium plumbate it had a lower sp gr and the lead actually used in paint formulations was the same

Paints containing calcium plumbate exhibited resistance to blistering on immersion in sea water absence of pitting and resistance to creep of rust under the film when abrasion exposed the metal and formed accidental anodes providing thereby that the compound was a general inhibitor for anodic and cathodic areas Best inhibitive effects of the compound were obtained in sea water immersions and in simple linseed oil or polymerized vegetable oil vehicles Due to the powerful rust inhibitive effect of calcium plumbate and the toughening influence it exerted on the paint film paints of high protective value could be formulated with large amounts of inert extenders The light colour of calcium plumbate permitted its use in a variety of tinted paints Further the calcium plumbate paint could be used direct in freshly galvanized iron without previous treatment and it does not crack or flake

Growth Abnormalities in Tobacco

RESULTS OF ANALYTICAL STUDIES on the growth responses of tobacco plants with amino acids are described (*Science* 1949 **110**, 714)

The symptoms of toxicity covered a wide range but were specific for each amino acid Abnormalities included inhibition of stem and branch elongation accelerated development of the leaves in the axillary buds and reticular chlorosis of newly expanded leaves together with greatly reduced leaf laminae (strap leaves) Increased leaf number was a prominent feature Similar responses to amino acids were obtained with tobacco plants growing in water culture and soil Frenching of oriental Xanthi tobacco was obtained with *dl isoleucine* at 20 p p m in water culture Partially sterilized soil required very large quantities however in order to produce the symptoms of Frenching in Connecticut broad leaf and Xanthi tobacco Large scale analytical studies with field plants confirm the interpretation that excessive accumulation of free amino acids in the plant may be a primary cause Free amino acids in leaf laminae of plants showing symptoms of mineral deficiencies increased with nitrogen deficiency by 32 per cent phosphorus 48 per cent potassium 58 per cent calcium 120 per cent magnesium 283 per cent and boron 27 per cent These values are maxima and confirm and extend the data of mineral deficiency studies with green plants The increases in free amino acids are considered to be the evidence that these chemical elements participate in protein metabolism and that formation of symptoms is primarily due to the localised action of excessively accumulated normal metabolites Growth responses and chlorosis with amino acids are of sufficient variety to include many of the individual symptoms comprising the syndromes displayed with mineral deficiencies Except possibly for magnesium break down of chlorophyll in mineral deficiency is therefore not necessarily indicative of mineral participation in chlorophyll formation as has often been assumed The probable participation of the chemical elements in the enzymes regulating protein metabolism warrants the exercise of caution in associating specific mineral deficiencies with physiological processes in the plant Drastic interference in the basic function of the plant should cause a breakdown in all physiological processes at varying rates

Electric Fences

THE USE OF THE ELECTRIC FENCE as an alternative to the more orthodox type of fence is discussed and the types of controlling units available in Great Britain and other countries are compared in a report (No W/T18) of the *British Electrical & Allied Industries Research Association*

The electric fence consists of one or more strands of fencing wire supported on insulations affixed to light wooden posts and connected to an energizing unit This unit is either an electromechanical or a purely electrical device which applies a high voltage between the wire or wires and earth at regular intervals so that any animal or human being coming into contact with the fence suffers an electric shock The electric fence differs from the more orthodox type in that the barrier provided by the fence is more psychological than physical since it controls not by force but by fear

An account is given of tests carried out upon three British units to check their compliance with the British Standard 1222 1945 and to determine whether they could be altered intentionally or otherwise so as to increase the severity of the shock given by them The advantages and disadvantages of these fences are discussed in detail

The electric fence offers two principal advantages over the orthodox type namely economy and flexibility Large fields can be protected from unwanted animals with little trouble or difficulty at a small running cost. — G D JOGLEKAR

Triethyl Phosphate

SOME OF THE LATEST USES TO which triethyl phosphate is being put in the U S A are described (*Chem Age* 1950 **62**, 266)

The compound is used in the preparation of diolefines polymerization of vegetable oils textile dyeing and the synthesis of insecticides It serves as an intermediate in the synthesis of the new insecticide tetraethyl pyrophosphate now replacing nicotine Triethyl phosphate is employed as a catalyst in the dehydration of glycols and olefinic alcohols for the preparation of diolefines such as butanediol pentanediol and hexanediol The polymerization of coumarone styrene cashew nut oil tung oil etc for the production of resinous compounds is effected with triethyl phosphate It is successfully employed as an additive to lubricating oils for high pressure work Lubricants containing triethyl phosphate are reputed to have comparatively flat viscosity temperature curves low pour points and high flash points The additive has only a very slight corrosive action on the common metals and the addition of 1 per cent of di isobutyl ketone reduces this action appreciably

In the textile industry triethyl phosphate is recommended as an aid to dyeing the phosphate being miscible with water ethyl alcohol ethyl acetate acetone benzene chloroform xylene isobutanol and castor oil Its use as an ingredient of sizing formulations has been patented

Urea formaldehyde Fertilizer

THE DEVELOPMENT OF A NEW urea formaldehyde compound as a source of nitrogen for tobacco fertilization is reported (*Chem Age* 1950 62 263)

Urea formaldehyde (urea form) in combination with cotton seed meal results in 16 to 23 per cent increase in grading and yield over cotton seed meal alone The combination material has an advantage over urea which produces too dark a colour in the tobacco leaf because of the rapid rate at which it releases ammonia In comparison with cotton-seed meal 4 per cent less dark leaf colour was produced with the urea form-cotton seed meal treatment A treatment consisting of a mixture of 25 per cent cotton seed meal gave best crop value

Waxes from Lignite

RESULTS OF A SURVEY CONDUCTED by the *American Bureau of Mines* concerning yields and properties of solvent extractable waxes from lignites are reported (*Industr & Engng Chem* 1950 **42**, 131)

The lignite coals gave yields similar to those obtained in commercial extraction of montan wax from German brown coal Although higher yields were obtained with a solvent mixture of benzene and alcohol than with benzene alone the properties of the benzene extracts more closely resembled commercial grades of montan wax than did the benzene alcohol extracts The most significant difference between the extracts obtained from American lignites in this investigation and the Riebeck brand of wax from Germany was the greater resin content of the extracts from the American lignites The benzene alcohol extracts had a higher content of asphaltic material than the benzene extracts

Turbidity Control

DEVELOPMENT OF A NEW ELECTRONIC device to provide a means for watching and detecting turbidity changes to the extent of one part in 1 00 000 in a clear liquid is reported (*BIS*)

The instrument is a photoelectric device with a special optical system for detecting particles of solid matter in a liquid The liquid runs through a glass tube around which the controlling equipment forming the sensing head is placed An intense beam of light passes through the liquid and the photo cell is so placed that it responds to any light scattered by particles that may appear in the liquid The response can be made to actuate the next operation or to pass or reject the liquid from the system

Analysis of Coal Ash

A NEW SCHEME OF ANALYSIS embodying several improvements in the quantitative methods of analysis of the constituents of coal and coke ashes has been worked out at the Fuel Research Station (*Survey Paper No* 50 *H M S O* London, Price 1*s*)

The principal changes in the methods previously reported (*Survey Paper No* 28) relate to preparation of ash for analysis solution of the ash separation of silica determination of barium treatment of the iron group determination of iron determination of titanium removal of platinum and manganese determination of magnesium phosphorus and alkalies The scheme is considerably simpler than schemes for the analysis of silicate mineral in general

Maturity of Cotton Fibres

A SINGLE CHEMICAL TEST TO determine how cotton fibres are likely to react during spinning and other phases of processing is being used by cotton mills in the United States The test which involves the use of a special mixture of red and green dyes quickly reveals whether fibres are mature or immature (*USIS*)

The new test is based on the fact that differences in dyeing properties of cotton are related to the maturity of the fibres When subjected to the operation thick walled or mature cotton fibres turn red in colour and thin walled or immature fibres turn green The test obviates the time expense and complications involved in the microscopic test

Analysis of Emodin containing Drugs

ALTHOUGH EMODIN CONTAINING drugs are quite potent and are widely used in medicine there has been no generally accepted method for assay and the present day procedure for testing water soluble or alcohol soluble extractives is not a very satisfactory means of evaluating these materials A spectrophotometric method for analysis of emodin in *Cassia acutifolia D* based on development of colour by the Borntraeger reaction is described (*J Amer Pharm Soc* 1949 38 589)

The dried senna powder was extracted with alcoholic potassium hydroxide the alcoholic solution was acidified and extracted with ether The ether solution was then shaken with ammonia test solution to extract the emodin and develop the measurable colour The method to be effective and accurate has to be supplemented by reference standards for the drugs

High Grade Aluminium Chloride

AN APPARATUS FOR THE PREPARATION purification and sublimation of aluminium chloride has been developed at the *Chemical Research Laboratory* England (*Chem Age* 1950 62 338)

The apparatus dissipates the heat of reaction the metal is used in the form of a stout rod so that heat is rapidly conducted away from the reaction zone The resulting aluminium chloride vapour is freed from chlorine by passing it over heated aluminium turnings or foil and is then projected through an orifice into the centre of a water cooled chamber Here it is condensed into solid particles before it can reach the cold wall of the chamber and collects in a free flowing condition The product is discharged from the cold chamber into the receiver flow is assisted by gentle vibration

Adhesive from Cashew-nut Shell Oil

THE POSSIBILITY OF PRODUCING cold setting adhesives from cashew nut shell oil has been investigated at the *Forest Research Institute* Dehra Dun (*Indian Forest Leaflet No* 111)

The adhesive is a polymerized product of the oil using sulphuric acid with addition of rectified spirit to increase miscibility of the oil and acid and of para formaldehyde as a hardener polymerization being effected by heating in an oil bath or water bath followed by oil bath Tests have also been carried out on the storage life of the adhesive influence of viscosity on adhesive strength and influence on the surface of the wood treated Results of tests on the use of the adhesive for bonding plywood have been tabulated

The products conform to British Standard Specifications

Manufacture of Boards

RESULTS OF INVESTIGATIONS ON the production of wood wool cement boards wood wool protein boards and various other types of hard boards from wood shavings and saw-dust are described in a leaflet recently published by the *Forest Research Institute* Dehra Dun

Saw-dust (80 to 100 mesh) was mixed with the following adhesive compositions (1) prolamin formaldehyde (2) groundnut protein formaldehyde and (3) phenol formaldehyde The mixture was conditioned in a kiln and then pressed at 320°F and 2 000 lb /sq in for half an hour The thickness was ¼″ When two adhesives were used i e groundnut protein formaldehyde and phenol formaldehyde the saw dust was first treated with the former conditioned and then treated with the latter The boards so prepared compared favourably with foreign boards Groundnut protein formaldehyde and phenol formaldehyde mixtures gave best results A small addition of coconut coir pith was found to improve water resistance Pretreatment of saw dust with ammonia reduced moisture absorption

Utilization of Wood Waste

THE POTENTIAL USES OF WOOD waste for making wall board and other materials of moulded construction were discussed at a recent conference of the *North Eastern Wood Utilization Council* at Harvard University (*Chem Age* 1950 62 260)

The relationship of the properties of fibre boards to their densities was discussed Soft boards with densities about 0 3 and hard boards with densities about 1 0 are common but semi hard boards (densities 0 5 to 0 6) and three-quarters hard (densities 0 7 to 0 8) were becoming important in Europe because they resembled wood more closely in working properties Such boards were made by wet processes using the Asplund defibrator or other disintegrating devices

Saw-dust could be processed dry into a hard board by mixing it with certain chemicals and then pressing hot The board obtained was strong had low water absorption and showed negligible swelling It could be laminated with metal foils or plastics Fire or pest resistance characteristics could also be imparted The Xilon process a semi-chemical process of pulping wood and other fibre wastes developed in Italy by *Aziende Brevetti Industrial* is now available in the United States A 2 per cent solution of sulphuric acid in open tanks is used The acid hydrolyses the pentosans in the wood and the softened wood is then neutralized and defibred mechanically, without removing the lignin. An example of wood waste utilization for moulded construction materials was demonstrated by *Durisol Inc.*, New York. Durisol consists of chemically treated wood shaving bonded with portland cement and moulded under pressure. The product was said to be fire resistant and to have good heat and sound insulating properties.

Lead Tetra-acetate

LEAD TETRA-ACETATE IS FINDING increasing applications as a highly selective oxidizing agent in the synthesis of various organic compounds. 1-2-glycols can be split into two molecules of aldehyde, the reaction being usually carried out in a solvent such as glacial acetic acid, benzene, dichlorethane and nitrobenzene. α-hydroxy acids can similarly be oxidized. Amino compounds like α-amino acids, 1, 2-amino alcohols and 1, 2-diamines can be split by the salt to form an imine which may be further dehydrogenated to the nitrile. Besides, lead tetra-acetate is of great value in the methylation of aromatics and in acetoxylation. The latter can be used for the conversion of various allenes to cyclopropanone derivatives.

The compound is unstable and decomposes even under best storage conditions. Rejuvenation can be effected by stirring the acetate with half its weight of a mixture of 8 parts glacial acetic acid and 1 part acetic anhydride and filtering off the solid tetra-acetate (*Chem. Age*, 1950, **62**, 302).

New Arc-welding Electrode

A NEW ELECTRODE, MANUFACtured in Australia, is especially suited to work on single pass horizontal fillets and multiple pass fillets in the vertical and overhead positions. It is also designed for work on vertical, horizontal and overhead butts in plates over half an inch thick. The electrode is an aid to faster welding and also possesses very low spatter loss, inherent self-cleaning properties, and gives an excellent appearance to the finished weld (*Tech Newsletter*, Australia).

New Soldering Iron

A SMALL 10" 3 OZ TOOL WITH A heating-up time of 6 sec and a current drain of 20 amp has been devised. The heat is generated at the copper tip which is utilized as a means to convey the heat to the work, instead of serving as a reservoir of heat, as in most types. The iron can be worked into positions through mazes of delicate wiring to reach inaccessible spots without radiating heat in all directions. Sufficient heat can be generated to melt special aluminium solder for which normally a gas jet has to be used (*Tech Newsletter*, Australia).

Equilibrium Data for Tin Alloys

EXISTING DATA ON THE THERMAL equilibria of the more important tin-containing binary metallic systems are summarized in a booklet recently published by the *Tin Research Institute*, England.

All the useful systems investigated to-date are represented. To make the information as concise and accurate as possible, a single diagram is presented for each system. To facilitate interpretation of the diagrams, temperature and composition, coordinates have been inserted in colour. Supplementary explanatory notes are appended to many of the diagrams and, where available, information on crystal structure is given.

A bibliography of publications on ternary tin alloy systems is included and contains references to all the ternary systems which have been fully or partly investigated and indicates the extent of the information available where an investigation is incomplete.

The booklet is priced *2s. 6d.* and is available from the Director, *Tin Research Institute*, Greenford, England.

Pilot Steel Works

A STEEL RESEARCH STATION THAT will have much of the equipment of a steelworks in miniature is being established by the *British Iron & Steel Research Association* at Sheffield. The cost of the first stage of development is estimated at about Rs. 33.33 lakhs.

Pilot plant for melting, rolling, drawing and forging for trial of research findings before application to production plant is to be installed. Steel melting will be carried out in 10 cwt. capacity electric arc furnaces.

Indian Standards

Iron Castings — THE DRAFT specification relates to grey iron castings which have been classified into 7 grades on the basis of minimum tensile strength. General requirements in respect of the process of manufacture, moulding and freedom from defects have been given. The dimensions of test bars, the tensile strengths of the various grades of cast iron, the requirements of transverse tests for test bars of various diameters, and the conditions of acceptance or rejection of material are also included.

Malleable Castings — The standard covers requirements of 3 grades of black heart malleable castings. Process of manufacture, freedom from defects and details of mechanical tests are laid down.

Laundry & Toilet Soaps — The standard for laundry soap prescribes the requirements for 3 grades of washing soap in respect of fatty acid and rosin acid contents, free alkali, moisture, chlorides, etc. The specification for toilet soap lays down the essential requirements for fatty acid and rosin acid contents, free and combined alkali and chloride. In both the standards, the methods of marking, sampling and tests are also included.

Steam Cylinder Oils — Six draft standard specifications for the following types of steam cylinder oils covering the entire range of lubrication requirements of steam cylinders have been formulated: pure mineral, ordinary, compounded, ordinary, pure mineral superheat, compounded, pure mineral filtered, and compounded, filtered. In each specification, general indication has been given of the service conditions under which the respective grade of oils is to be used.

Comments on these draft standards will be received by the Director, Indian Standards Institution, 19 University Road, Delhi 2, up to July 20, 1950.

Cement — Draft standard specifications have been prescribed for ordinary portland cement, rapid-hardening cement and low-heat cement. The standard covers the requirements of ordinary portland cement for general use as a constructional material in concrete, mortar, etc., and rapid-hardening portland cement for use where low heat and hydration is required, as in mass-concrete for dams. The standard lays down the chemical and physical requirements for the materials. The methods of sampling and tests and of storage of the material are given The tests are included in the form of 7 appendices.

Indian Journal of Meteorology & Geophysics

THE INDIAN METEOROLOGICAL Department has discontinued publication of the series " Scientific Notes " and instead has started a new quarterly journal under the above title. The first number of the journal (Jan 1950) contains useful contributions on " Foreshadowing Monsoon and Winter Rainfall " and " Geophysics in Mineral Prospecting "

Announcements

The Fourth International Congress on Large Dams and the *Sectional Meeting of the World Power Conference* are to be held in New Delhi from 10th to 15th January 1951 An Exhibition of Engineering Activities relating to conservation and utilization of water and power and allied research is also to be held concurrently

A symposium on the history of science in South Asia, sponsored by the National Institute of Sciences of India in collaboration with the *UNESCO* Science Co-operation Office for South Asia is to be held in Delhi in September 1950 Dr Joseph Needham, F R.S , a noted authority on the history of science and evolution of scientific thought, is expected to preside A small study group of scholars from India, Pakistan, Ceylon, Burma, Malaya, Siam, Indonesia and China will participate in the symposium.

Symposium on Polymer Chemistry — A three-day symposium on " Polymer Chemistry as Applied to Plastics " is to be held in London under the auspices of the Society of Chemical Industry in September 1950. Contributors may communicate with the Hony Secretary, Advisory Service on Plastics and Rubber, Ministry of Supply, R716, Shell Mex House, London, W C. 2

International Meeting on Rubber Technology is to be held under the auspices of the American Chemical Society in Cleveland, Ohio, U S.A , from 11th to 13th October 1950 Papers are to be submitted before 1st July 1950 to the Secretary of the Division of Rubber Chemistry, Binney & Smith Co., 41 East 42nd Street, New York 17

The Association pour L'Utilisation et la Diffusion de la Documentation have published a list of documents (in French) on German chemical industry during the war They have also prepared a classified catalogue (in French) of German patents deposited in the German Reichspatentamt (State Bureau of Patents) between 1940 and 1945 These catalogues can be obtained direct from the Association, 18 Avenue De Villars, Paris 7, or through *UNESCO* Science Co-operation Office, University Buildings, Delhi.

Royal Society Medalists — The two Royal Society Medals for 1950 have been awarded to (1) Sir George Thomson for his contributions to atomic physics and for his work in establishing wave properties of the electron and (2) Prof A Peters for investigations of (i) the biochemical rôle of vitamin B in tissue metabolism and (ii) the mechanism of toxic action of arsenical compounds.

The Electrochemical Society Inc — A section of this Society for India has recently been organized with headquarters at Bāngalore The section, which is the first to be formed outside the U.S A , was inaugurated in March 1950

Mosanto Chemicals Ltd have organized a new company, Mosanto Chemicals of India Ltd , in India, which plans to establish a selling organization in India and eventually manufacture products commanding a ready market from indigenous raw materials.

Dr Vaman Ramchandra Kohatnur — We regret to record the death of Dr Vaman Ramchandra Kokatnur in New York on the 14th April 1950 at the age of 63 A noted consulting chemist and engineer, Dr. Kokatnur had been in the U S A where he carried out considerable research work covering new processes in engineering and various branches of chemistry He was at one time a special consultant to the U.S. Navy. In 1928 he went to Russia as consulting expert on the five-year plan, specializing in the uses of chlorine and caustic soda In 1940 he was honoured as an outstanding inventor at the sesqui-centennial celebrations of the U S Patent Office He was a member of leading scientific groups in America and was on the Advisory Board of the Watumull Foundation.

Publications Received

Railway Track, by ANTIA, New Book Co Ltd , Bombay, 1949, pp 19 + 416, price Rs. 16

Engineering Economic Analysis, by BULLINGER, McGraw-Hill Book Co Inc , New York, 1949, pp xii + 397, price $ 4 00

Psychical Physics, by TROMP, Elsevier Publishing Co Inc , New York & London, 1949, pp xv + 534, price $ 8 00

The Chemistry & Metallurgy of Miscellaneous Materials, Thermodynamics, by QUILL, McGraw-Hill Book Co. Inc , New York, 1950, pp xxii + 329, price $ 3 00

Engineering Supersonic Aerodynamics, by BONNEY, McGraw-Hill Book Co Inc , New York, 1950, pp xi + 264, price $ 4 00

Layout Planning Techniques, by IMMER, McGraw-Hill Book Co Inc , New York, 1950, pp viii + 430, price $ 5 00

Aircraft Structures, by PERRY, McGraw-Hill Book Co Inc., New York, 1950, pp vii + 566, price $ 6 50

Solvents, by DURRANS, Chapman & Hall Ltd , London, 1950, pp xv + 242, price 21*s*

Non-linear Vibrations in Mechanical & Electrical Systems, by Stoker, Interscience Publishers Ltd , London, 1950, pp. xix + 273, price $ 5 00.

Application of the Electronic Valve in Radio Receivers & Amplifiers, Book IV, by HAANTJES & SUCHTELEN, Phillips Electrical Co. (India) Ltd , Calcutta, 1950, pp 24 + 416

Paper Base Laminates, by SORRELL, Cleaver-Hume Press Ltd , London, 1950, pp 223, price 12*s*. 6*d*

Flood Estimation & Control, by RICHARDS, Chapman & Hall Ltd , London, 1950, pp xiii + 173, price 21*s*

Progress Reports

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

RESEARCH ON VARIOUS ASPECTS OF AGRICULTURAL crops fruit technology and animal husbandry conducted under the auspices of the Indian Council of Agricultural Research is reviewed in its 18th Annual Report for the year ended 31st March 1948

The rice research scheme started at Baroda in 1940 came to a close during the year The investigations carried out have revealed that the open cultivated paddy benefits by two irrigations Green manuring was better than keeping the land fallow The application of castor cake (60 lb /acre) also gives high yields In Kashmir the Chinese variety of paddy gave heavy out turns (60 to 70 md /acre) In the rice disease scheme in Madras treatment of the seed (1 gm /lb of seed) with the fungicide Argosan GN has been found to prevent the blast and the foot rot diseases

The work on wheat rust schemes conducted during the year at the Indian Agricultural Research Institute New Delhi and at Agra Simla Hosangabad and Mahabaleshwar stations has resulted in the evolution of several promising varieties of wheat resistant to yellow and black rusts A Wheat Rust Control Committee was appointed during the year to intensify and co ordinate research on wheat rust throughout the country

Under the pulse research scheme in Madras field trials have shown that horse gram and black gram grown as mixtures gave higher monetary returns than pure crops In the Bombay *jowar striga* scheme it was found that the variety *Bongankilo* was the most resistant to both species of *striga*

A scheme for scientific aid to the paper industry submitted by the Government of Madras and another for the survey of soil and climate conditions under which cashew nut trees grow were sanctioned

Over 200 blight resistant hybrids approaching commercial potatoes both in tuber size and yields have been evolved through a series of back crosses of *Solanum demissum* with *Solanum tuberosum* at Simla

Investigations on the colloidal constituents of Indian soils have been undertaken by the Council with a view to (1) the elucidation of their fundamental electrochemical character as manifested in their base exchange properties their manner of association in the soils and their influence on soil properties (2) differentiation of clays present in various soils and the identification of clay minerals contained in them (3) elucidation of soil forming processes These investigations are expected to throw light on the difficulties of minor or trace elements e g Mn Sn Cu etc in Indian soils and suggest measures for remedying such deficiencies

The preparation of a monograph on phosphate manuring in India has been sanctioned by the Governing Body of the Council

Studies on the preservation of citrus juices with special reference to their vitamin C contents have shown that flash pasteurization is a satisfactory method Chemical preservation with sulphur dioxide has also proved satisfactory The juices should be deaerated and the sugar concentration raised by the addition of sugar (5 per cent) Ordinary pasteurization and addition of sodium benzoate caused deterioration in the quality of juices

Investigations on the comparative nutritional value of *vanaspati* and ghee have shown that there is 15 25 per cent less absorption of carotene with *vanaspati* as compared with cow ghee In another set of experiments it was found that *vanaspati* lowered the absorption rate of calcium and phosphorus The low nutritive value of *vanaspati* was due to factors other than digestibility

Studies have been made on the nutritive value of indigenous grasses and wheat barley millets and paddy straws with special reference to their effect on milk production Alkali washed paddy straw augmented milk production in cows where as water washing alone had no such beneficial effect

The Council has sanctioned a scheme of research to investigate into the possibility of using milch cows for work and to see if there is any deterioration in the milking capacity The scheme has been started on the analogy of the prevailing practice in Egypt where milch cattle are worked without any adverse effect on milk yield The Council sanctioned another scheme on the standardization of the technique of manufacture of ghee to improve its market quality

A scheme for drying prawns has been successfully worked out at the Madras Fisheries Station

BUILDING RESEARCH IN ENGLAND

RESEARCH ON BUILDING MATERIALS BUILDING construction design and performance of structures soil mechanics fire resistance and colonial housing and building formed the bulk of general research and co-operative investigations undertaken by the Building Research Station D S I R London (*Building Research* 1948 H M S O Price 1*s* 6*d*) during the year 1948 Apart from these reports on 63 special investigations were issued during the year The materials examined included clays bricks building blocks and various aggregates Investigation on composite timber sheet joists for houses reinforced concrete floors shale and pulverized fuel ash for brick and tile making and air infiltration through windows were a few others

Work on the foaming of clays for making light weight insulating materials were undertaken during the year Specimens with a reasonably fine porous structure have been made with ball clay Cornish china clay residues were investigated as possible concrete aggregate A report on limestone aggregates is nearing completion Studies on light weight aggregates such as clinker vermiculite expanded clay and foamed slag have been undertaken in connection with the setting up of a pilot plant The exfoliation of vermiculite and the properties of concretes with exfoliated vermiculite as aggregate have also been investigated and a special investigation has been carried out on concrete made with expanded clay While the results of the latter were similar to those normally obtained with this material the trial is interesting in that the clay was artificially expanded by the incorporation of a gas producing chemical prior to burning In co operation with the inventor some tests have been made on the product obtained from a new and simplified method of foaming slag Investigations on steam curing of concrete have been widened and a pilot scale test plant has been installed As a first step in the work on quality control of concrete a detailed study has been made of concrete from different sources

A method for analysing set concretes and mortars has been developed in conjunction with the Road Research Laboratory In connection with the programme of research on aluminium powder foamed concrete a method of assessing the suitability of different powders has been evolved

Lime wash containing tallow for the surface treatment of bituminous roofing materials have been found effective and free from harmful effects on the bituminous surface Wool grease may be used as a substitute for tallow although it is not quite so durable Another promising alternative is a stearate of a heavy metal Such treatments are found to be more resistant to weather if applied to rough rather than to smooth surfaces in particular a sand finish to a self finished roofing felt improves both the life of the felt and that of an applied lime wash Several new varieties of building board made from wood waste glass fibre and peat have been tested

An instrument has been designed to enable the flow properties of a layered material to be assessed The instrument is a constant rate penetrometer the needle being forced into the specimen at a constant rate The load is measured by the deflection of one of a set of calibrated steel strips

Investigations have been made on the design of wall ties stiffening effect caused by floor coverings fixity to stanchions etc on floors and roofs A review of the work on the strength and stability of various types of house construction has been prepared for publication

A series of tests on a model bridge consisting of steel girders with concrete jack arches spanning between the girders has been completed Revised methods of design practice based on the results of the tests are likely to be introduced Tests were also carried out on full size and model concrete walls to determine their structural behaviour under aerial and eccentric loading Research on soil mechanics was closely linked with field investigations and practical problems of foundations for large structures and stability of earth slopes in relation to water flow were investigated

Heating tests on 20 houses under unoccupied conditions were completed during the year and trials are being continued by remote control with the houses occupied by tenants Several papers have been published on the results of the tests studies on heat transmission through roofs and physiological investigations on the effect of warm and cold walls on comfort have been continued

A mobile laboratory for measuring sound insulation and acoustical properties of buildings was completed and put into use

The Board stressed the importance of making the results of the work known to industry by all possible means particularly through the Codes of Practice now being prepared

Government of India Scholarships

FIFTY SENIOR AND 150 *JUNIOR* RESEARCH scholarships have been instituted by the Ministry of Education Government of India for training scholars in scientific and industrial research in universities and other educational and research institutions in India in pursuance of the recommendations of the Scientific Manpower Committee The senior scholarships are of the value of Rs 200 per month and are awarded to research workers who have taken at least a Masters Degree in science or a good Degree or advanced Diploma in Engineering or Technology The junior scholarships (Rs 100 per month) are awarded to those possessing at least a good Honours Degree in Science or a Degree in Technology

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India* Part II Section 1 for April 1950

Paints Varnishes & Lacquers

42187 Electrical insulating coating compositions *A mixture of an etherified melamine formaldehyde resin a partial polymeric ester of a polyhydric alcohol and an aliphatic x dibasic* Indestructible Paint Co Ltd

41720 Ammonium nitrate blasting explosives *Incorporating in ammonium nitrate blasting explosive composition* 0 001 *to* 1 *per cent of dyestuff of sulphonated aromatic character* — I C I Ltd

42146 Chlorination of acetic acid *Passing a mixture of sulphur dioxide and chlorine into acetic acid in the presence of substances promoting the formation of sulphuryl chloride* — Koninklijke Industrieele Maatschappij Voorheen Noury & Van Der Lande

40498 Ventless delay initiators for explosive or other charges capable of exothermic reaction *Fuse elements consisting of flexible envelope surrounding an unbroken continuously extruded core of thermoplastic composition comprising inorganic reducing agent and oxidising agent powders* — I C I Ltd

Organic Chemicals

40612 Extraction of cellulose from vegetables *Pre digesting the vegetable material with alkaline sodium lye and thereafter further digesting with sodium monosulphite lye* — Lemaire

41312 Preparation of phenols *Adding quicklime to a solution of salt of sulphonic acid drying and heating the mixture in presence of steam* — De Directie Van De Staatsmijnen in Limburg

42276 Preparation of pyrimidine compounds *Treating 2 thiol 4 amino pyrimidine with chlor acetic acid and recovering corresponding 2 carboxymethylthio 4 aminopyrimidine* — The Wellcome Foundation Ltd

42312 Preparation of stable vitamin A composition *Adding an antioxidant to a solvent for vitamin A and then adding vitamin A or a vitamin concentrate to the mixture* — The Bengal Immunity Co Ltd

Instruments (Professional Scientific & Controlling)

40361 Apparatus for electric arc seam welding *Welding electrode having a curved surface for the root of the arc moving relative to welding head in a direction opposite to the movement of the seam relative to the head at such a speed that the arc is held in a given position relative to the welding head* — The General Electric Co Ltd

Metal & Metal Products

42488 Treatment of manganese ore *Heating ore containing* MnO_2 *initially in air and then in oxygen to get a mixture of* Mn_3O_4 *and* Mn_2O_3 — Chatterjee

41979 Process of treating nickel bearing iron ores of the Mayari type *Comprises heating at* 1000°F *and* 1500 F *a bed of turbulent fluidized thermally homogeneous gaseous suspension and another bed of fluidized ore in a reduction zone reacting the former with the latter in the reduction zone* — The Dorr Co

41803 Production of zinc *Condensing zinc vapour in molten lead until the concentration exceeds* 1 7 *per cent and cooling the lead zinc solution to a temperature above the freezing point of zinc but at which molten dissolved zinc separates* — The National Smelting Co Ltd

Textile & Textile Products

40366 New fluorescent compounds for use in textile treatment *Reacting cyanuric chloride with* 4 4 *diaminostilbene* 2 2 *disulphonic acid dimethylamine or morpholine and an amine* — I C I Ltd

41059 Process for the extraction of textile gum from *Urginia indica* *Sleeping onions in solution of pressing agent then relieving same of water soluble glucoside thereafter drying the scales* — Seth

42546 Hand threading shuttles for looms *Shuttle eye consisting of a thin disc having a vertical slot extending from top to the centre the disc being located in a recess in the shuttle head* — Thomas Dawson (Shuttlemakers) Ltd

40444 Composition for decorating textiles *Applying on a fabric composition comprising a pigmented dispersion and preferably a gel dispersion of a polyethylene in a volatile organic liquid and heating the fabric* — Interchemical Corp

Miscellaneous

42014 Continuous treatment of vegetable fibres *Additional liquid is pumped into the tower at the lower end thereof and the descending material is agitated at said lower end followed by withdrawal of the treated fibres* — Cellulose Development Co Ltd

41930 Quick extraction of glue from bones *Subjected to high pressure steam of* 40 *lb for* 5 *min and to* 30 *lb for half an hour and then glue is extracted in about* 4 *hr* — Moorthy & Director Central Laboratories for

Continued on page 226

Patented Inventions of the Council of Scientific & Industrial Research

CONVERSION OF BHILAWAN SHELL LIQUID

SEVERAL PROCESSES HAVE BEEN PATENTED FOR the conversion of bhilawan shell liquid to a non-vesicating drying product which can be used for the manufacture of lacquer varnishes, stoving enamels, waterproofing, electric-insulating and plastic compositions or like materials

Patent No. 28002

S. SIDDIQUI & S. K RANGANATHAN

Bhilawan shell liquid is heated with sulphur so as to raise its temperature gradually, keeping down the rate of heating at about 200°C when there is evolution of hydrogen sulphide and frothing of the mixture and subsequently raising the temperature to, and heating the mixture at, about 280°C. The sulphur content may vary from 0 5 per cent to 5 per cent by weight of the bhilawan shell liquid

Patent No. 28003

S SIDDIQUI & S K RANGANATHAN

Bhilawan shell liquid is cooled to 0°C. or below and mixed with nitric acid, stirring the mixture vigorously Excess of water and an organic solvent such as methyl-ethyl-ketone or benzol are added to the mixture The aqueous layer is drained off, the supernatant layer is washed with a carbonate or bicarbonate solution and water and the product is dried The solvent may be added to bhilawan shell liquid before the addition of nitric acid Nitric acid may be produced in the nascent state in the reaction mixture by the addition of commercial saltpetre to a mixture of the shell liquid and concentrated hydrochloric acid. For example, a solution of bhilawan shell liquid in benzol is mixed with concentrated hydrochloric acid and warmed before the addition of saltpetre. The quantities of the liquid, the solvent, the acid and saltpetre that are used for the mixture are preferably in the proportion of 8.32 11 3 by weight.

Patent No. 28004

S. SIDDIQUI & A. A. KHAN

Bhilawan shell liquid is heated at a temperature not below 100°C alone or in contact with metals whose melting points are below 1000°C. or with their alloys, amalgams, or their oxygen, sulphur and halogen-containing compounds. Some of the metals that may be used are aluminium, zinc, lead, bismuth, tin, mercury, sodium or antimony The compounds referred to above may be the oxides or sulphides of the metals or their salts with mineral acids, higher fatty acids, resinous acids or resinols. Heating is done with or without aeration Example Bhilawan shell liquid is heated with tin for 2 hr at 100° to 120°C followed by further heating for 2 to 3 hr at 300° to 320°C. The product, on cooling, is a black solid, which is soluble in hydrocarbon solvents and is used in the manufacture of a plastic composition

Patent No. 28005

S. SIDDIQUI & A A KHAN

Bhilawan shell liquid is heated with an acid and an aldehyde (or a polymer or derivative of an aldehyde such as paraformaldehyde, trioxymethylene or hexamethylene tetramine) The reaction product is washed free from acid and excess of aldehyde and dried The quantities of the acid and the aldehyde in the mixture may vary from 2 5 to 10 per cent and 5 to 20 per cent respectively, by weight, of the bhilawan shell liquid The temperature at which the mixture is heated may vary from 80° to 110°C. and the duration of heating from 1 to 3 hr Example A mixture of 100 parts, by weight, of bhilawan shell liquid, 5 parts of concentrated hydrochloric acid and 10 parts of a 40 per cent formaldehyde solution is heated for about 2 hr at a temperature of 100°C., the heated product is washed several times with water and finally dried at a temperature of 115°C The dried product is cured preferably at a temperature varying from 100° to 200°C.

INDIAN PATENTS — *Continued from page 225*

SCIENTIFIC & INDUSTRIAL RESEARCH, HYDERABAD, DECCAN

42147. Method and apparatus for the extraction of oils from vegetable matter such as seeds, nuts and beans *By conveying a slurry consisting of pulverised raw material and solvent through a plurality of zones of differential pressure* — ROSE, DOWNS & THOMPSON LTD

42620. Composite products of rubber and textile material : *Impregnating with rubber containing a hydroxy di or tri-arylmethane or their halogenated derivatives*—DUNLOP RUBBER Co LTD.

41915 Removal of mist and dust from gases *Passing through a plurality of apertures and temporarily reversing the direction of flow by impingement on suitable surfaces* — I C I LTD.

Ore Dressing & Mineral Beneficiation

THE setting up of a well-equipped Ore-dressing and Mineral Beneficiation Division of the National Metallurgical Laboratory, Jamshedpur, will be warmly welcomed by industries interested in the production and utilization of minerals It is probably the best equipped laboratory in India, competent to undertake a wide range of standard beneficiation tests on ores

There was little or no research in India on ore-dressing problems before World War II , there was hardly any institution with even the basic equipment required for systematic ore testing The *Indian Copper Corporation Ltd* had established a testing laboratory at their Moubhandhar Works, as an adjunct to the flotation plant, for assessing the changing characteristics of the ores The Utilization Branch of the Geological Survey of India, which was started in 1942 for exploiting the deposits of strategic minerals, was faced with the problem of developing several low grade ores At the request of the Geological Survey, the *Indian Copper Corporation Ltd* placed their ore-testing laboratory at the disposal of the Government, and several investigations on beneficiation of low grade ores were undertaken Towards the end of 1945, the Utilization Branch of the Geological Survey was wound up and all ore-testing work had to be stopped

The Indian Bureau of Mines, set up by the Government of India in 1947, concerned as it is with the conservation and planned utilization of mineral resources of the country, is faced with the problem of utilizing the large quantities of low grade ores accumulating at mine sites during the last few decades The utilization of these ores involves the testing of a large variety of materials from different parts of the country for their amenability to beneficiation processes and the determination of optimum working conditions for recoveries

The National Metallurgical Laboratory at Jamshedpur, which is one of the eleven National Laboratories established by the Council of Scientific & Industrial Research, has now set up a well-equipped ore-dressing laboratory* which would be in a position to undertake such investigations

Scope for Ore Testing

The value of the total annual production of minerals in India is estimated to be 60 crores of rupees India, however, is far behind other countries in the application of ore-dressing techniques to the development of her immense mineral wealth Most of the manganese ore, magnesite, chromite,

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* The Division is housed in one of the five bays (each measuring 100′×40′) in the Technological Block The crushing section is adjacent to the ore-dressing bay and is equipped with the following machinery (1) one Denver laboratory forced feed jaw crusher, 5″×6″, with 5 h p motor , (2) one Denver laboratory forced feed jaw crusher, 3½″× 2½″, with 1 h p, motor , (3) one Denver laboratory crushing roll (type M), 10″×6″, with 2 h p motor , (4) one Denver McCool laboratory pulverizer, No 9½K , 5 h p motor , and (5) one Denver-Dillon double-deck vibrating screen, 12″×24″, with ½ h p motor

Samples for batch-testing investigations are received in 3 cwt lots and, after weighing on Avery's platform weighing machines, are crushed and subjected to various tests

Batch Testing — For gravity concentration tests, 2 mineral jigs (No 1 M, and one of 4″×6″ size), both of the *Denver Equipment Co* , are provided A Denver Wilfley concentrating table No 13A, 40″×18″, with two decks (one for sands and the other for slimes), and a 9″ Denver centrifugal classifier are available for batch testing

Batch grinding can be effected in a 12″×5″ Denver (open) batch mill Where a uniform feed without much fines is required, the Denver laboratory rod mill (7″×14″) will prove serviceable ilmenite zircon monazite kyanite etc produced in India is exported for processing abroad Minerals intended for export should conform to certain grades and specifications and to secure exportable qualities selective mining and crude dressing method e g hand picking have been adopted These practices have led to the accumulation of appreciable quantities of unmarketable grades *in situ* or in dumps

Taking the case of the manganese mining industry it is reported that about 40 million tons of high grade ore have been exported from India during the past few decades On a conservative estimate about half of this quantity should have accumulated during all these years in the mining centres as low grade ore It should be possible to recover at least half of this quantity as high grade concentrate through suitable processing This means that India's manganese ore reserves can be increased by 10 million tons from the old workings alone The present average annual production of marketable manganese ore is estimated to be 6 00 000 tons This results in an equal tonnage of low grade ore which goes into dumps from which about 1¼ lakh tons of marketable ore can be recovered India possesses a minimum reserve of 15 20 million tons of metallurgical and chemical grade manganese ores but the reserves of low grade ores are several times this quantity

India has large reserves of iron ore containing over 60 per cent iron sufficient to last for a few hundred years at the present rate of consumption The fines produced during mining operations which are not suitable for use in blast furnaces are rejected at the mine site and only the coarse sizes are utilized

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For agitation of cyanide pulps amalgamation tests and grinding with pebbles a Denver bottle type agitator with 4 numbers of 24″ rollers which can take at a time 4 numbers of trojan type porcelain jars (capacity 1 4 gal) is employed The Denver super agitator can be used for conditioning and agitating cyanide pulps at varying speeds and for the determination of settling rates Three spherical bottom pyrex jars of capacities 6 6 12 7 and 19 litres are available for use with the agitator

Four laboratory flotation machines (2 of 500 gm 1 of 1 000 gm and 1 of 2 000 gm capacity) are installed for batch testing *Filtration* of the test products is carried out in Denver vacuum filters (12″ × 3″) or counter balanced pressure filters (12″) or filter flasks with Buchner funnels whichever is convenient The products are dried in a Denver laboratory oven No 12

A sieve shaker which can hold 7 Nos of 8″ × 2″ sieves is employed for screen analysis Tyler standard sieves are in use for all sizing work and a complete set of these is kept in stock from 1 05″ opening to 325 mesh the openings decreasing in the ratio of $\sqrt[4]{2}$ or 1 189

The products are sampled with a Jones laboratory sample splitter (10″ × 18″) Conventional methods can be adopted for smaller quantities using chilled iron bucking boards and mortars and pestles for grinding purposes

A laboratory electromagnetic separator (type D No O) manufactured by *Stearns Manufacturing Co* is erected for magnetic separation of minerals and one electrostatic separator (model B 1 12 of *Messrs Sutton Steele & Steele* Texas) will soon be installed for the separation of minerals with different electrical properties

The Humphrey s spiral concentrator (No 24A angle 5 turns) which is to be installed shortly would be useful for the separation of heavy minerals in batch or continuous tests

Continuous Testing — The batch testing units and the working benches for sampling and processing occupy about one half of the bay The continuous testing plants are to be erected in the other half The following pilot plants will be shortly installed

Dorr Company s counter current decantation plant consisting of 3″ 10″ dia × 10″ deep agitator 3″ 18″ dia × 12″ deep thickeners and 3 diaphragm pumps All parts coming into contact with solutions are made of stainless steel This plant is useful for cyanidation of gold ores and leaching and other operations employing counter current decantation

A laboratory experimental sink and float plant (*Huntington Heberlein & Co Ltd* London) with a capacity of 200 lb of ore per hour and employing galena as the medium The preparation of the medium from raw materials and the reclamation of galena will be carried out in the Denver continuous plant

Denver Equipment Company s continuous pilot plant to treat 200 500 lb of ore per hour This comprises an ore feeder a ball mill a cross flow classifier a hydro classifier a mineral jig a unit flotation cell 2 conditioners 12 Nos of No 7 flotation cells a spiral thickener a drum filter vacuum equipment 4 wet reagent feeders a dry reagent feeder a pulp sampler 2 sand pumps and 2 Wilfley tables (50″ × 24″) The crushing unit is not included in this plant as the ore will be reduced to the size suitable for the ball mill in the crushing section situated in the adjoining room This continuous plant can be used for combined gravity (jigging and tabling) and flotation treatments and for selective flotation of one or more minerals

The Ore-dressing Division is equipped with V 41 mineral light for the identification of minerals using ultra violet light a D F C electric assay furnace with automatic temperature control for gold and silver fire assays a Bausch and Lomb stereoscopic wide field binocular microscope a Denver Havard double beam trip scale a solution and pulp scale hand amalgamation pans and vanning plaques

Many million tons of accumulated fines could be washed to produce high grade concentrates low in objectionable impurities These and the blue dust containing over 68 per cent iron, available in large quantities, can be sintered and utilized in blast furnaces

The magnesite and chrome ore mining industries in India are also operating under similar conditions Only the hand-picked concentrates are utilized for export or local consumption Low grade ores are rejected

Indian beryl is obtained by hand-picking the crystals from the field Sometimes hand-cobbing is adopted to separate the crystals from the matrix It is reported that there are large reserves of beryl-containing rock in the country which can be mined and the beryl separated by flotation processes

The occurrence of fluorspar has been reported from a few places in Central Provinces and adjoining States At present India's requirements of this mineral are met almost wholly by imports If the reported deposits are sufficiently large, though of low grade, it should be possible to process them for the production of metallurgical fluorspar Acid grade fluorspar required for the manufacture of hydrofluoric acid can be, likewise, obtained

The lead-zinc ores of Zawar (Rajputana), the apatite deposits of Singhbhum, the monazite-ilmenite sands of Travancore are among the other minerals that can be enriched by ore-dressing processes Glass sands can be purified, and cryolite can be recovered from carbon dust of the aluminium reduction furnaces at Asansol and Alwaye by suitable methods These instances are only indicative of the range of materials that are amenable to treatment by beneficiation processes

Service Facilities

The Ore-dressing Division of the National Metallurgical Laboratory is equipped for batch as well as continuous tests on minerals

Batch tests provide all the requisite information on the amenability of minerals and rocks to different treatment methods and the optimum conditions for attaining efficiency with any of the processes Although a commercial size plant designed and based on the results of batch tests can be reasonably expected to duplicate the results obtained in the laboratory, it is advisable that a continuous test on a pilot-plant scale should be performed The results of such tests provide more reliable information than those obtained from batch tests, especially regarding the behaviour of middling products, the use of reclaimed water in the mill and the classification of flotation feeds

The primary aim of this Division is to render every possible assistance to industries interested in mining and minerals utilization The laboratory will undertake the testing of samples from deposits and provide specifications for machinery required for processing The laboratory will also advise on the erection and operation of ore-dressing plants in the country

G P CONTRACTOR
P I A NARAYANAN

Census of Trained Personnel

THE INITIAL VOLUME OF THE NATIONAL Register of Scientific and Technical Personnel in India, published by the *Council of Scientific & Industrial Research*, catalogues the names of engineers under the following heads civil, electrical, mechanical, chemical, marine and mining The information furnished is classified further to give information on the academic and professional qualifications, practical experience—its nature and scope—, addresses, present occupation and nature of employment held Apart from being an effort towards the stock-taking of scientific personnel in the country, the National Register provides a continuous census of scientific manpower and will assist in the effective utilization of scientific talent, assessing gaps in the growth of science and technology and supplying service personnel to industry and to educational and research institutions.

Sir Edward Mellanby, Director, Central Drug Research Institute

SIXTY-SIX-YEAR old Sir Edward Mellanby, who has been appointed Director of the Central Drug Research Institute, Lucknow, is one of Britain's foremost medical scientists. Three years ago he was awarded the Buchanan Medal of the Royal Society "for his services to medical science and in recognition of his outstanding researches on dietary factors"

He has been a pioneer in the study of diet and nutrition, and for the last 16 years he has carried on his work concurrently with directing medical research throughout Britain, for he is the Secretary of the Medical Research Council

Born at West Hartlepool, County Durham, in 1884, he was educated at Barnard Castle School and Emmanuel College, Cambridge, where he was a scholar, research student from 1905 to 1907 and later an honorary fellow He took his M.A and M D, doing his hospital course at St Thomas', London, where he afterwards began his teaching career as Demonstrator in Physiology From 1913 to 1920 he was Lecturer and later Professor of Physiology in London University (King's College for Women), he then went to Sheffield as Professor of Pharmacology until 1933, when he received his appointment as Secretary to the National Medical Research Council He had been a member of the Council for two years. In 1935 he was elected Fullerian Professor of Physiology to the Royal Institution

Sir Edward Mellanby

Research on Rickets

One of Dr Mellanby's early pieces of research concerned the physiological effects of alcohol, an investigation which he undertook for the Government during the first World War Around this time the late Sir Frederick Gowland Hopkins was carrying on his research which led to the determination of the vitamins, and Dr. Mellanby also did pioneer work in this field. By dietetic experiments on puppies he found that rickets was caused by an absence from their diet of a fat-soluble substance which controlled the deposition of calcium in the bones This anti-rachitic substance later received the name of vitamin D

In 1925 the Medical Research Council published a report of further experiments by Dr. Mellanby on these lines, establishing the fact that bread and cereals tended in themselves to cause rickets, later he identified the rachitic substance in a cereal diet as phytic acid, and found that it could be counteracted by adding vitamin D or extra calcium A later series of publications demonstrated that actual bone changes in shape could be caused by faulty diet; following up this line, Sir Edward — he received the K C.B in 1937 — proved that lack of vitamin A causes abnormal bone growth and neurological disorders due to pressure of the overgrown bone.

His investigations have included a study of the effects of lack of iodine, and one of his researches demonstrated that bread made from flour bleached chemically by the Agene process (NCl_3) can cause the condition in dogs known as canine hysteria.

In 1925 Dr Mellanby was elected a Fellow of the Royal Society. He had become a recognized authority on nutrition, and was member of successive committees appointed to advise the Ministry of Health. He worked for the League of Nations, was Chairman of two International Conferences for the Standardization of Vitamins and of the International Technical Commission on Nutrition.

Sir Edward Mellanby was Honorary Physician to the King from 1937 to 1941. He held many other important positions during World War II. He was chairman of a committee which investigated and advised on the health of flying and naval personnel and has been, since 1940, a member of the Scientific Advisory Committee to the Cabinet. In 1941 he was appointed a member of the Colonial Products Research Council, and in 1945, chairman of a medical research committee to advise on colonial problems.

Sir Edward Mellanby's wife, whom as May Tweedy he married in 1914, is like himself a distinguished scientist.

Lady Mellanby has specialized in research on the effect of diet on dental health, the Medical Research Council published a three-volume report by her on this subject between 1931 and 1934. Her work on the teeth of London school children has been outstanding.

She is an honorary member of the British Dental Association and an investigator for the Medical Research Council, in 1935 she and her husband were jointly awarded the Charles Mickle Fellowship of the University of Toronto.

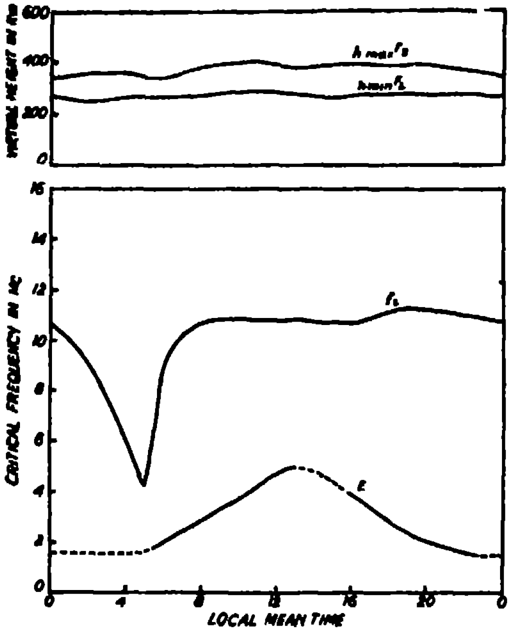
Characteristics of the Ionosphere over Calcutta (April 1950)

S S BARAL, R K MITRA, D C CHOUDHURY,
R B BANERJEE & A P MITRA
Ionosphere Laboratory, University College of Science, Calcutta

THE following are the ionospheric data observed at Calcutta for the month of April 1950.

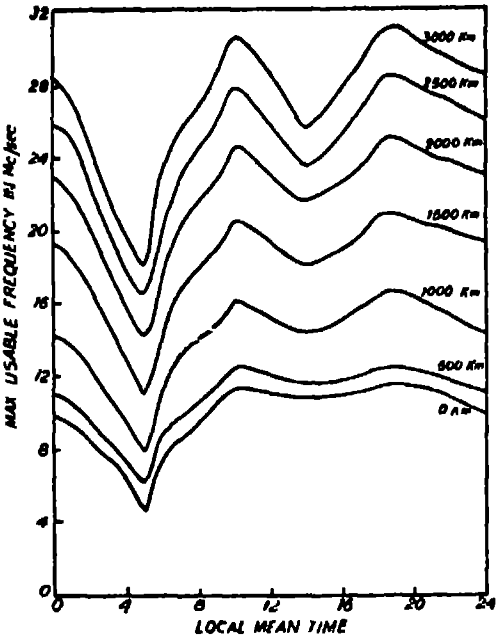
Fig. 1 represents the mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 in graphical form. The figures are obtained from average values of the data taken for each hour of the day for 5 days a week. Fig. 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of July 1950. Table I gives the different occasions during routine observations when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights.

Sporadic E ionization was found to occur frequently during evening and night with infrequent occurrences in the mornings. The frequency of occurrence was found to be less than that at the same time last year. It is of interest to note that the weather was less turbulent this year than last year. This suggests a relation between weather conditions and occurrence of sporadic E. Normal E echoes were frequently absorbed during midday and early afternoon. Region F_2 ionization was found to remain steady up to midnight with a slight rise late in the evening.



(5 hr 54 min ahead of G M T)

Fig 1 — April 1950



At point of reflection

Fig 2 — Predicted M U F via F_2 layer during the month of July 1950

TABLE I

Month & year	Date	Hour	f^0E_s Mc	^hE_s Km
April 1950	4	00 00	5 00	140
	5	20 00	3 75	125
	6	18 00	2 45	100
		22 00	2 20	90
		23 00	2 25	105
	11	09 00	3 90	125
		19 00	4 15	135
		17 00	3 35	130
	15	22 00	3 00	130
	18	23 00	2 25	105
	19	07 00	5 00	140
	20	18 00	3 00	130
		19 00	2 00	105
		20 00	2 50	105
		21 00	2 10	105

TABLE I — *contd*

Month & year	Date	Hour	f^0E_s Mc	^hE_s Km
April 1950	21	10 00	6 20	135
		18 00	3 50	130
		21 00	4 25	140
		22 00	3 00	135
		23 00	5 00	130
	22	00 00	3 00	130
	27	08 00	10 00	140
		17 00	4 85	120
		21 00	1 80	105
		24 00	1 70	105
	28	08 00	3 00	120
		18 00	4 00	125
		20 00	3 00	120
		21 00	2 80	120
		22 00	2 65	120
		23 00	5 00	125
	29	00 00	3 00	130
		08 00	4 00	135

Detonation & Molecular Structure

G BROERSMA
Djakarta, Indonesia

SOME years ago the author published a report[1] on detonation measurements in the so-called Duchene apparatus (to be compared with a single stroke engine), which consisted of flame pictures, pressure and ionization diagrams As a result of this and other researches, two mechanisms of detonation were indicated, viz (1) the mechanism defined as physical detonation, in which by physical processes of aerodynamic flow, mixing and diffusion a critical stage is reached at which the speed of the flame front changes from the normal subsonic rate to a supersonic rate, and (2) the mechanism defined as chemical detonation, in which by chemical processes of chain reactions in the end-gas a critical stage is reached when the end-gas ignites at one or more points From these points combustion proceeds at normal subsonic speeds Each one of the two mechanisms has its own time constants, depending upon thermodynamic, chemical and geometric conditions of the vessel in which the combustion takes place They may, under certain circumstances, overlap, that is to say, when chemical detonation has started physical detonation may follow, but not the reverse

Another attempt to combine "auto-ignition" and the detonation wave theories into a single theory has since been made by Miller[2] According to Miller, detonation of a comparatively low pitch may be caused by ignition of the end-gas itself at a rate too slow to produce audible gas vibrations Detonation involving both low-pitched and high-pitched tones may be caused by ignition of the end-gas followed by the development of a detonation wave in the end-gas Detonation of high pitch may be caused by a detonation wave in after-burning gases behind the flame front This wave may also pass through the unignited end-gas The finding of Miller on the explosive detonation reaction is that it is a self-propagating disturbance travelling through the last parts of the gas burning at a speed ranging about the speed of sound to approximately twice that speed.

Chemical Detonation

In considering the mechanism of chemical detonation, one may speculate on the relation between the structure of the hydrocarbon molecules and this type of detonation (*Mutatis mutandis* on the influence of detonation inhibitors or of detonation accelerators) What happens in the burning gas and also in the end-gas may lead to chemical detonation As has been shown[3-5] time has a great influence on the occurrence of detonation, i e the faster the combustion proceeds, the less time there is for reaching the critical stage of "auto-ignition" of the end-gas From this point of view, if the structure of the hydrocarbon in any way influences the detonation, it can manifest in two ways firstly by influencing the speed of combustion of the original flame front, secondly by influencing the reactions in the end-gas

Reynolds and Ebersole[6] published measurements on the effect of hydrocarbon type and chain length on uniform flame movement in quiescent fuel-air mixtures They found that the peak-flame velocity increased with increased unsaturation in a molecule of a given size That is to say, *cet par*, that as reactions in the end-gas are allowed a decreasing amount of time to develop towards a critical stage, the chance of detonation decreases For the unsaturated compounds, the peak-flame velocity decreases as the chain length increases, i e *cet par*, that as events in the end-gas are allowed an increasing amount of time to develop towards a critical stage, the chance of detonation increases The peak-flame velocity of the saturated straight-chain compounds was essentially the same.

Detonation & Molecular Structure

The experiments of Lovell[7] give an insight into detonation and the molecular structure.

The outstanding characteristic of hydrocarbons is the quite regular and consistent relationship between their tendencies to detonate and their molecular structure.

From the data given for all classes mentioned, it appears that (1) the critical compression ratio — before detonation starts — decreases when successive carbon atoms are added to a straight chain, (2) the critical compression ratio increases when the atom is added so as to form a branch, and (3) the critical compression ratio increases when the molecule becomes more centralized.

The results presented in the report of the American Institute of Petroleum Research, No 45 (A P I 45) are overall results and do not definitely show where the quality of a fuel becomes manifest whether in the speed with which the gases burn during combustion — that is its influence on the time factor — or in the way events happen in the end-gas (or — before this — during the intake and/or compression in the engine, or in both).

As for these "events" in intake during compression and in the end-gas during combustion, one is accustomed to speak of (1) the incubation period, (2) the pre-reaction period, and (3) the combustion period.

To start the so called pre-reactions, some dissociation must be present. It is supposed that such dissociation is present under the usual conditions in the intake; moreover it increases with increasing temperature when the mixture proceeds along the intake, comes into the cylinder and finally is compressed. The initial dissociation will be caused by the impact of the various molecules. As the speed of the molecules increases with increasing temperature, dissociation will also increase.

Increasing temperature will increase the initial number of reacting molecules and the reactions will be accelerated.

During the pre-reaction stage, all kinds of compounds may be formed as, for instance, amines, amides, alcohols, aldehydes, peroxides, ozonides and acids. During the pre-reaction period, one compound may be transformed into another. With normal combustion, if the flame front starts and passes through the mixtures, everything breaks down again into CO_2 or CO, H_2O_2 and N_2. In chemical detonation, however, there first will be a building up of these compounds, then a critical stage will be reached at which they will break down faster than they are being built up due to temperature conditions. This faster breakdown causes the mixture to combust internally, i e before the original flame front has passed or, in extreme cases, even before it has started. In Lovell's report indications are available of the influence of the pre-reaction period when the use of super-fuels is referred to. In the above-mentioned compounds the occurrence of oxygen compounds is conspicuous. There are definite indications that these compounds play a considerable part in the course of the pre reaction stage[4,5,6].

It is proposed to study the above "events" more carefully, especially from the point of view of molecular structure, detonation inhibitors and detonation accelerators. The case of paraffins, olefines di-olefines naphthenes and aromatics will also be considered.

The Molecular Structure of Hydrocarbons

The molecular structure of a hydrocarbon has to be taken spatially although for the sake of simplicity, one is usually satisfied with the chemical structural formula as written on paper. Even if the plane of symmetry were to contain the centre of gravity of the nuclei electrons, even then the molecule will have another dimension, be it infinitely small as compared with other dimensions.

Paraffins — If the molecules are looked upon as fixed moving objects it is clear that with a straight-chain hydrocarbon the longer it is the more chance there is for it to collide with another object and, if this is a small one, to "catch" it (FIG 1). Also, if such a collision occurs between two big objects,

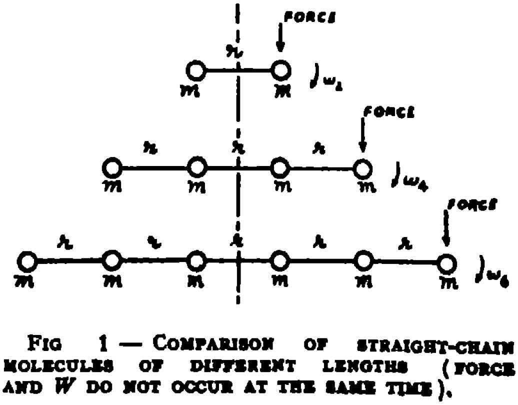


FIG 1 — COMPARISON OF STRAIGHT-CHAIN MOLECULES OF DIFFERENT LENGTHS (FORCE AND W DO NOT OCCUR AT THE SAME TIME).

the longer the chain the greater the chance of the chain breaking down

Comparing inertia forces of chains with 2, 4 and 6 carbon atoms, it follows that the longer molecules offer higher resistance to movement than the shorter ones If the force is applied with a certain speed, a certain amount of energy must be transmitted. A molecule will transmit part of the energy of its rotation and another part into its inner construction, that is to say, that the bonds will have to absorb that energy The less is absorbed by the rotational movement, the more will have to be taken up by the bonds So the longer molecule will have a larger load applied to its bonds than has the smaller one, and stands a higher chance of breakdown Therefore, the longer a straight-chain hydrocarbon the greater the chance for it to attach to itself another atom such as oxygen and/or nitrogen, but if the temperature increases and with it all the speeds of the molecule, the greater is also the chance that it will break down again

The movement of the molecules is proportional to the temperature, and the energy of the molecules is equally divided over the possible degrees of freedom translational, rotational and vibrational If the temperature increases, then these energies increase

The translational speeds of the molecules are not equal but vary according to a distribution first used by Maxwell We shall, however, confine ourselves to average speeds (and energies) in this paper

If hydrocarbons have the same temperature, they will have the same amount of energy if a calculation involving rotational energy shows, in the case of the three molecules, that the centrifugal force on the bonds is larger as the molecule is shorter, under the same temperature conditions But as this force is opposed by attractive forces of a kind inversely proportional to the radius, a smaller molecule will shorten and, one may say, stabilize itself somewhat more than a longer one No actual change in the volume of the molecule need occur, only the attractive fields on force which surround it diminish in strength and it seems, therefore, as if the molecule has decreased in volume The shorter molecule, therefore, will less easily attract other atoms, e g dissociated oxygen and/or nitrogen atoms than a longer molecule[9]

In order to appreciate the difference between a straight-chain molecule and a centralized one, one might, for instance, compare a straight chain of 5 atoms (or groups) with a compact molecule wherein the bonds extend radially from a central atom to 4 other atoms (FIG 2) The figure shows the projections of both molecules on the plane of symmetry, i e the plane perpendicular to the vector of the maximum moment of inertia The straight-chain molecule extends farther into space in one direction, on the other hand, the compact molecule extends into space more evenly into two main directions From a geometrical point of view, the chances of catching dissociated atoms of oxygen and/or nitrogen appear to be equal for both types of molecules The difference in the chances that they may break down would be the straight-chain molecules of different lengths From considerations of inertia forces it can be argued that the bonds of the straight-chain molecule will be more heavily loaded than those of the compact molecule at a collision, the straight-chain molecule will have a greater chance of breakdown

Comparing what happens when both molecules are subjected to the same tem-

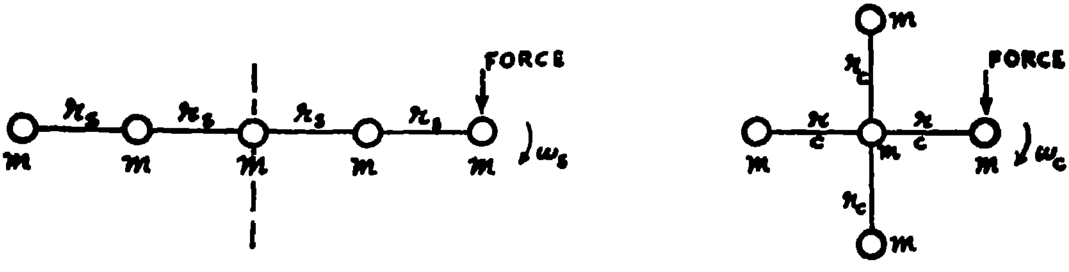


FIG. 2 — COMPARISON OF A STRAIGHT-CHAIN MOLECULE WITH A COMPACT MOLECULE (FORCE AND W DO NOT OCCUR AT THE SAME TIME)

perature, it is found that the centrifugal force on the bonds is the average for the compact molecule again involving calculations of rotational energies By applying the same reasoning as applied before to the straight-chain molecules, it now appears that the compact molecule will attract less easily other atoms as, for instance, dissociated oxygen and/or nitrogen atoms than a straight-chain molecule of the same number of atoms, mass and bond dimensions From this it follows that with increasing chain length, i e with increasing number of carbon atoms, the quantity of pre-reaction products will increase These products will also be less stable as the chain is longer Therefore, with an increasing number of carbon atoms, the straight-chain paraffins will have an increasing inclination to detonate, *cet par*

Furthermore, the more compact the molecule, the fewer and more stable will be the pre-reaction products Therefore, with increasing compactness the paraffins will have a decreasing inclination to detonate, *cet par*

Both these findings agree with A P I 45, from which it may be seen that the critical compression ratio decreases with the increasing number of carbon atoms and increases with increasing compactness

The difference shown in A P I 45 as to the influence of the centralization of the molecule, or of adding methyl groups is a difference in the compactness of the molecule Centralization, which indicates the greatest benefit with respect to the allowable compression ratio, is actually the best way to make a molecule stable and compact Adding methyl groups instead of hydrogen atoms, however, has a stabilizing influence with a lower benefit as to allowable compression ratio than has centralization

Olefines — The olefines have the same general formula as the naphthenes C_nH_{2n}, but are of open structure, whereas the naphthenes are of cyclic construction. Compared with the paraffins, the olefines have two hydrogen atoms less, they fail at adjacent carbon atoms (FIG 3)

A kindred consideration as for the paraffins holds good also for the olefines Typical differences are due to the double bond in the molecules of the olefines so that the pre-reaction products of the olefines are formed much more easily than those of the paraffins It appears that the olefines have a strong inclination to add atoms or groups to carbon atoms with double bonds There will be more pre-reaction products with olefines than with paraffins under similar conditions On the other hand, the resulting molecules are more stable than the original ones That is to say, compared with the intermediate products of the paraffins originated during the pre-reaction stage, those of the olefines are more stable Under similar conditions, therefore, there would be less chance for a sudden breakdown of the pre-reaction products of the olefines than those of the paraffins Thus, if it is known which of the two properties dominates in a certain olefine, it can be determined whether an olefine is more or less inclined to detonate than the paraffin having the same number of carbon atoms It may be stated, however, that the addition of oxygen or nitrogen makes itself felt more if there are fewer carbon groups, for then the influence of the double bond is greater

Comparing olefines and paraffins, the difference between pre-reaction products should be greatest between the molecules with the least number of carbon atoms, and should decline with the increasing number of carbon atoms Also the difference between the inclination to detonate would be largest between the molecules C_2H_6 and C_2H_4, and this would decrease with the increasing

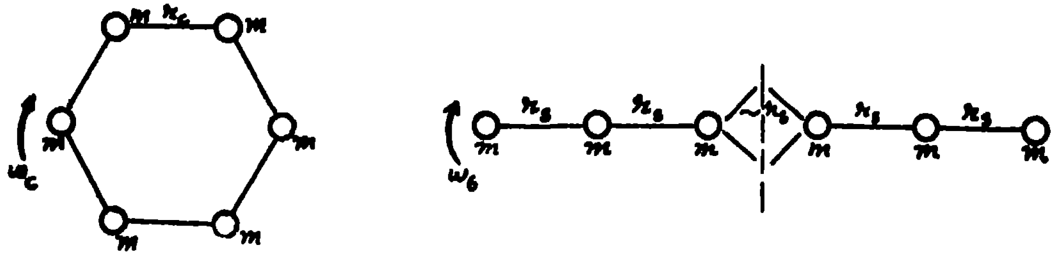


FIG. 3 — ELECTRON BOND DIAGRAMS FOR DIFFERENT MOLECULES.

number of carbon atoms. This is confirmed by A P I 45.

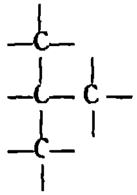
Di-olefines — The di-olefines have two double bonds as compared to the olefines. The general formula is C_nH_{2n+2}. It is to be expected that in their behaviour the di-olefines will show properties which are similar to those of the olefines, though in a more pronounced degree.

Naphthenes — The naphthenes are saturated hydrocarbons of cyclic structure. The molecules seem to be rather flattened. The general formula is C_nH_{2n}. The cyclic construction causes compact molecules to "catch stray oxygen/or nitrogen atoms with some difficulty. Their stability considering their symmetrical cyclic construction, is favourable. Comparison shows that their bonds are taxed higher than straight-chain molecules with the same number of carbon atoms under similar temperature conditions (FIG 4).

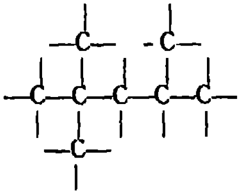
It may be shown that the centrifugal force on the bonds of cyclohexane for instance is higher, being 50 per cent above the average than any of the forces on the bonds of the olefine. The field of force, therefore, is smaller around cyclohexane than around the corresponding straight-chain molecule C_6H_{12} (*see* FIG 4). Cylohexane will therefore less easily attach stray atoms to itself than C_6H_{12}. Cyclohexane is an example of a structure where the connecting bonds of the carbon atoms nearly lie in the direction which is natural to them[19]. This also causes it to be very stable. This is even more the case with cyclopentane. In accordance with the foregoing, it can be easily deduced from A P I 45 that cyclohexane is superior to straight chain C_6H_{12} and cyclopentane is superior to cyclohexane.

Aromatics — The basic aromatic is benzene, C_6H_6, whence all the others are derived. Benzene has hexagonal cyclic structure with three double bonds (it is possible that the three bonds move around the molecule). Often a structure is assumed with six bonds directed centrally. This last representation forcibly accounts for the good anti knock properties of benzene and its derivatives, as may be inferred from A P I 45.

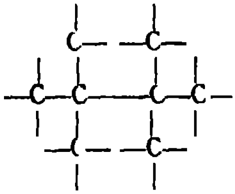
The Structure — From A P I 45 it is conspicuous that the group



has very favourable anti-knock properties. One can see it in *iso*-octane



and still more in the octane



which is twice as resistant to detonation as the former.

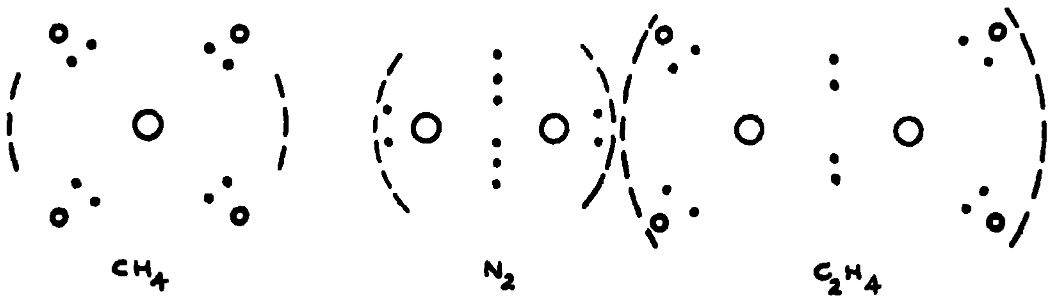
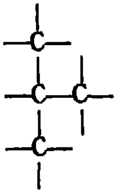


Fig 4 — Comparison of a naphthene molecule with an olefine molecule with the same number of carbon atoms (a double bond is open *see* Fig 3)

Furthermore, in all hydrocarbons where this group is added, the anti-knock properties increase many folds This is very likely due to the following The group



will have the connecting bonds of the carbon atoms in their natural direction and will be of very stable construction When added to a hydrocarbon, it either dominates the rest or else may stabilize the rest by calling for an opposite and also stable construction by its field of force and mass distribution

Sensitivity — The characteristics mostly used for the designation of hydrocarbons are the anti-knock value (octane number) and the permissible compression ratio These are measured on standard engines under standardized conditions If, however, the engine or the conditions are changed, these characteristics generally attain another value This property of a hydrocarbon might be called its sensitivity

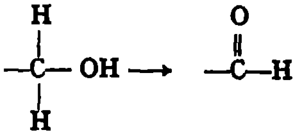
A P I 45 gives measurements where the critical ratio under one set of conditions (*C F R*-F-1, research method), has been plotted against the critical compression ratio in the same engine under another set of conditions (*C F R*-F 2, motor method) for paraffins and aromatic hydrocarbons Paraffins appear to be the least sensitive Under severe conditions, however, their sensitiveness increases appreciably (the only exception being *iso*-octane) Some aromatics are very sensitive others less or not at all Cyclo-paraffins are more sensitive than paraffins

It may not be far-fetched to connect sensitiveness with the pre-reaction stage of the combustion An aromatic like benzene, for instance, may under certain conditions form an ozonide, which is very unstable and has "explosive" properties[10], i e it breaks down suddenly and causes auto-ignition of the end-gas and therewith detonation The sensitiveness of benzene is great for these particular conditions If another aromatic with side chains, under any conditions in the intake and the compression stages, does not go beyond some aldehyde or alcohol formation, then that aromatic shows little sensitivity

Pre-reactions — To fit in our problem more or less in the general picture of combustion, it may be considered in three stages (1) the incubation period, in which first contact (collisions) occur between the hydrocarbon(s) and the oxygen and nitrogen of the combustion gases, (2) pre-reaction period, in which oxygen and nitrogen of the air are "reacting" with the hydrocarbon(s), i e all kinds of oxygen and nitrogen compounds are being formed, and (3) complete combustion in which the hydrocarbons are broken down completely to CO_2 CO and H_2O

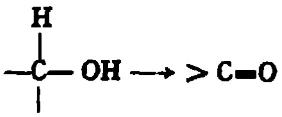
Of these three stage, we may discuss the second stage in chemical formulae, viz formation of alcohols aldehydes, peroxides, ozonides, amines and amides In all cases, we shall consider compounds having the least number of oxygen and/or nitrogen atoms attached to the hydrocarbon If the temperature conditions in the intake, the carburettor or the cylinder (during compression) allow the formation of the compounds mentioned in a certain engine and if some of the formations are preparatory to detonation then a hydrocarbon is regarded as "sensitive" The reactions mentioned will be examined for paraffins, olefines, diolefines, naphthenes and aromatics

Paraffins — Methane and ethane only produce primary alcohols, propane may produce a secondary alcohol (in its isomers) Butane may produce a tertiary alcohol From the primary alcohol an aldehyde may be derived



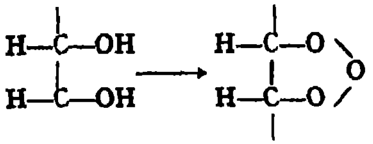
$$-\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{|}{\underset{|}{C}}}}-OH \longrightarrow -\overset{\displaystyle O}{\overset{\|}{C}}-H$$

In the aldehyde occurs a group $-\overset{\|}{C}-$ and a hydrogen atom which is so easily oxidized that an aldehyde withdraws oxygen from the somewhat unstable oxides Once aldehydes have been formed from peroxides for instance, further breakdown of peroxides is accelerated From a secondary alcohol a ketone may be derived But ketones are not easily oxidized



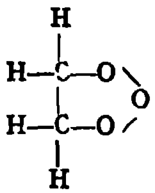
$$-\overset{\displaystyle H}{\underset{|}{\overset{|}{C}}}-OH \longrightarrow {>}C{=}O$$

From a tertiary alcohol, an ozonide may be derived



Higher alcohols occur with ozonide isomers. The secondary, whence ketones may be derived, are difficult to oxidize. From the tertiary alcohols ozonides are formed with difficulty. That means that with isomers the oxidation is far more difficult than with normal compounds. If peroxides and/or ozonides occur with the isomers, these compounds will be more stable being built more centrally than those of the normal molecule.

The formation of an ozonide from CH_4 needs the coupling of two CH_4 molecules.

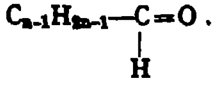


That is to say, CH_4 and C_2H_6 will have the same ozonide. The formation of this ozonide from CH_4 is less probable than that from C_2H_6, since in the former it requires the meeting of two molecules of the hydrocarbon, apart from the attachment of the oxygen atoms. Since there is a chance for the ozonides to detonate, under identical conditions CH_4 will show less tendency to detonate than C_2H_6.

The Formations

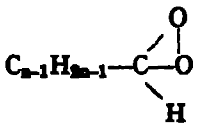
(1) $C_nH_{2n+2}+O \rightarrow C_nH_{2n+1}—OH$ alcohol

(2) $C_nH_{2n+2}+O—2H \rightarrow$



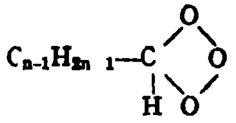
$C_{n-1}H_{2n-1}—\underset{\displaystyle H}{\underset{|}{C}}=O$. aldehyde

(3) $C_nH_{2n+2}+2O—2H \rightarrow$



peroxide

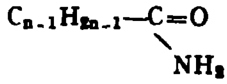
(4) $C_nH_{2n+2}+3O—2H \rightarrow$



ozonide

(5) $C_nH_{2n+2}+H+N \rightarrow$
$C_nH_{2n+1}NH_2$ amine

(6) $C_nH_{2n+2}+O—H+N \rightarrow$



$C_{n-1}H_{2n-1}—C{=}O \quad \diagdown NH_2$ amide

The above formations indicate the possible reactions. They cover the least amounts of oxygen and nitrogen.

These products may occur in the intake in gaseous form or they may occur in the cylinder during the compression stroke.

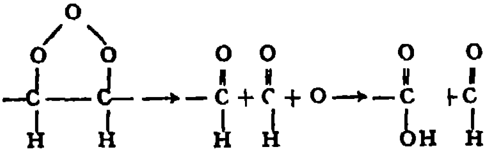
It will be seen that these reactions take in dissociation products. They are called chain-absorbing or chain-forming reactions. They may occur together in a definite way and where the pre-reactions involve condensation, it indicates that during compression also the pre-reactions will be accelerated according to the principle of Van't Hoff-Le Chatelier. So, if the pressure is increased, that reaction which affects the least number of molecules will start.

It is not difficult to see that with an increasing number of carbon molecules in the hydrocarbon, the quantities of oxygen or nitrogen required decrease for all reactions. That is to say, a higher hydrocarbon the easier it is to form these products. As these products may initiate the final detonation, it also means that the inclination to detonate increases with the higher degree of a hydrocarbon.

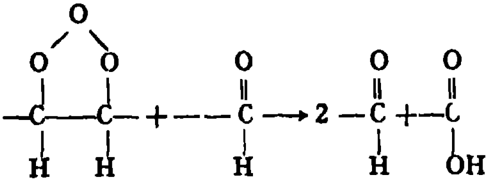
Breakdown of Products — During the compression stroke in the cylinder, and also during the compression of the end-gas by the burning gases, pressure and temperature are constantly increasing, and this means increase in translatory rotation and vibratory energy (in equal parts).

The increase in translatory energy means faster-moving molecules and more collisions, more chance of the formation of new compounds but also of a breakdown. The increased rotational energy means first of all more compact molecules (fields of force) until a critical point is passed when the molecule breaks down[9] The increase in vibrational energy means a continuous loosening and fastening of the bonds, and this causes the molecules to become increasingly unstable

The demolition of the products considered above can be envisaged chemically in the following way an ozonide releases an oxygen atom and then breaks down into two aldehydes whilst one of the aldehydes absorbs the oxygen atom, forming an acid



An ozonide together with an aldehyde may form two aldehydes together with an acid The H atom next to the carbonyl group is easily oxidized into an aldehyde The aldehyde has strong reducing tendencies and the oxygen of an unstable oxygen com pound, even as an ozonide is therefore, easily withdrawn by an aldehyde



In the two last reactions one sees that during the demolition of the products formed in the first stage of the pre-reactions the number of molecules again increases Apart from the piston compression and/or that of the burnt gases in a further stage, this also causes a rise in pressure

This might happen locally, influenced by certain catalysers and cause a local rise in pressure and total combustion[11] Since H and O atoms are present in the breakdown stage, a branched-chain reaction may start as follows

$$H+O_2 \rightarrow OH+O$$
$$O+H_2 \rightarrow OH+H$$
$$OH+H_2 \rightarrow H_2O+H$$

In the first reaction of this link, for every disappearing active part two new ones reappear This constitutes the branching of the chain reaction This is to say, even if only a few active parts occur at first, the number rapidly increases as does the speed of the reaction with the branched-chain reactions simultaneously

If the supply of the active oxygen parts, for instance, increases rapidly, the branched-chain reaction may attain such a speed that it leads to total combustion and detonation As an example we may draw attention to the positive influence of ozone[10] Here we have at work two opposite influences — the increasing pressure would produce reactions that decrease the number of molecules, while the increasing temperature breaks down the ozonides and induces reactions that increase again the number of molecules

It is to be expected that aldehydes, peroxides and ozonides in this order, will in increasing measure, enhance the chance of detonation In the same order they are less stable with reference to the oxygen, and will speed up the chain reactions Similarly if the formation of the oxygen compounds mentioned can be retarded directly or indirectly the chance of detonation will decrease This can be done, for instance by choosing suitable intake conditions (mild engine) and also by lowering all temperatures when using a rich mixture With such a mixture combustion is not complete In addition to CO_2 CO is also formed As CO has an appreciably lower combustion value than CO_2, all combustion temperatures will go down

Another effect of an increase in mixture strength is that there are increased quantities of hydrocarbons for the same quantity of combustion air This means that under the same conditions the temperature will be lower — in reality the same number of dissociation products of the combustion have to be used to produce an increased number of hydrocarbons Then there will be retardation in forming for instance, higher oxygen compounds as there will be less oxygen present per hydrocarbon molecule This also increases the chance of attaining a critical period in the pre reaction stage

Lower combustion temperatures may also be obtained by the injection of water

Quite recently Wheeler, Downs and Walsh[11] announced their finding that of all the intermediate products of combustion the peroxides are the only ones which possess an appreciable pro-knock effect Wheeler further found that a rise in pre-flame peroxide takes place prior to top dead centre, followed by a much higher peak value just before the flame With the increase of compression ratio, there is an earlier rise in pre-flame peroxide concentrations, and much higher peak value. The curves of peroxide concentrations vs crank angle are two stage in nature. For compression ratios from 7 to 9.9, they find peroxide concentrations of about 15-30 × 10^{-6}. The effect of tetra-ethyl-lead is to lower the concentration of the peroxides. The effect confirms the two-stage nature of the curves[12].

Aldehyde curves run parallel to the peroxide curves. The maxima are about 30 times greater. Tetra-ethyl-lead uniformly decreases the aldehyde concentrations at all points.

As regards the nature of the aldehydes produced, repeated tests with dimedone gave only the formaldehyde derivatives[12].

Walsh[13] gives the following chain reaction for peroxide formation

$$\begin{array}{ll} RH & \rightarrow R+H \\ R+O_2 & \rightarrow ROO \\ ROO+RH & \rightarrow ROOH+R \end{array}$$

and so on.

These degradations are complicated by the decomposition of alkyl and peroxide radicals, the former to olefines.

Thermal explosion may occur at high temperature because of greatly increased radical decomposition. Decomposition of ROOH, but no ROO, is assumed to be catalysed by aldehydes, thus explaining the apparently greater stability of ROO.

Olefines — The double bond, which means two pairs of electrons, is slightly open as the bonds will try to assume their natural direction (tetrahedron). They may be opened still further with no great effort to form linkages with dissociated oxygen, with nitrogen and also with hydrogen, that is to say, the olefines first saturate the double bond.

Two atoms of oxygen, hydrogen and/or nitrogen are taken in when the double linkage opens symmetrically as compared with the corresponding paraffins, the olefines absorbs more dissociated products (oxygen, hydrogen, and/or nitrogen) at less cost of energy of the molecule, because no other atoms (hydrogen) have to be removed. Karrer[10] has drawn attention to the easy addition of ozone to olefines. The ozonide formed is " explosive ", forming 2 aldehydes or ketones together with water.

The number of atoms that may start a branched-chain reaction is thus lessened considerably.

The effect of " detonation inhibitors " — iron carbonyl and nickel carbonyl — may be explained by assuming that they accelerate the binding of hydrogen atoms by unsaturated hydrocarbons.

Generally it would appear that, as regards detonation, olefines will be better than paraffins.

Di-olefines — What applies to the olefines, applies in an increasing measure to the di-olefines, due to their triple bond, as compared with the double bond of the former.

Naphthenes — As observed earlier they are chemically very stable, in fact, more stable than the paraffins.

Aromatics — The basic aromatic, benzene, may take on hydrogen and change to cyclohexane, thus reducing the number of hydrogen atoms that may start a branched-chain reaction. If, however, ozone has been formed during the pre-reaction stage, an ozonide of benzene may appear. This ozonide is very unstable and has an " explosive " character[10]. It might induce combustion of the end-gas.

The behaviour of benzene depends a great deal on conditions of reaction. It may have a high anti-knock value or a low anti-knock value. Its sensitivity is high. Toluene and other derivatives favour the formation of oxygen and other compounds more readily than does benzene. They approach paraffins in their behaviour with increase in the number and length of branches. The anti-knock behaviour also varies accordingly.

Heron and Beatty[14] draw attention to the fact that the aromatics have a higher latent heat of evaporation than the paraffins.

In the intake, the incubation stage of the aromatics will proceed slower than that of the paraffins. In general, there will be more delay. Thus aromatics might benefit in this way more or less, and have better anti-knock properties than paraffins. Leary, Taylor and Jovellanos[15], however, think that the excellent anti-detonation properties of benzene appear to be due to the slowness of the pressure rise in the combustion of the end-gas, rather than to an exceptionally long delay period. These two views, apparently in contradiction, are reconcilable in view of the fact that the former speaks of the delay period in the intake, while the latter considers the subsequent delay period during compression (due to piston or moving flame front)

Conclusions

The distinction made between physical and chemical detonation is justified by the possibility of dealing with all detonative phenomena from one point of view Miller s work strengthens this belief

Thus fundamental concepts of mechanics physics and chemistry may be combined with experimental evidence on detonation to further elucidate the nature of detonation Good agreement can be shown to exist between theory and experiment

In some respects theory lags behind experiment Jost s theory on the effect of lead if elaborated might close the gap to a certain extent The same may be said of further research in the borderland of chemical and physical detonation Here reference has been made especially to the explosive reactions of ozonides These reactions may start from physical detonation

Generally speaking mild pre reaction may initiate chemical detonation and severe pre reactions may cause physical detonation

To reach the critical stage of physical detonation physical processes of flow mixing and diffusion must be applied to ensure the necessary formation of an explosive kernel in which ozonides have been formed This also shows how the two phenomena may overlap In recent literature a survey is given of Muffling s theory on explosive reactions[16] Elsewhere Karpov[17] has made combustion calculations where the pre reaction stage had to be taken into consideration in order to explain the thermal ignition process

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Engineering Exhibition 1951

The Central Board of Irrigation Simla has issued the prospectus of the Indian International Engineering Exhibition which will open in New Delhi in January 1951 The Exhibition is being held during the meetings of four international organizations also to be held in New Delhi The Organizations are the World Power Conference the International Commission on Large Dams the International Commission on Irrigation and Canals and the International Association of Hydraulic Structures Working and still models depicting the latest developments in the science and techniques covered by the above international organizations will be on show during the exhibition which will last for a month

Microwave Spectroscopy & Its Applications

A PANDE*
All India Radio Lucknow India

MICROWAVE spectroscopy is the cross-road of infra red spectroscopists nuclear physicists and electronics engineers It is also one of the few cases where development of technique in electronics have opened a new field in pure physics It is similar to optical spectroscopy in principle but differs widely in technique range of electromagnetic spectrum resolving power etc In optical spectra especially in line spectra electronic structure of the atom is studied whereas microwave spectroscopy is used to investigate the molecules in their vibrational and rotational states as is the case in the band spectroscopy Microwave spectroscopy can be used to study heavy molecules which cannot be studied very effectively with optical techniques and it is very effective for investigating effects of the nucleus upon the molecular spectra Its resolving power is about 1 00 000 times that of the best infra red grating spectrometer due to which it promises to be one of the most powerful methods yet developed for the study of nuclear spins and nuclear quadruple moments Microwave spectroscopy region can be specified as the region between the long wavelengths of infra red and the longest wavelengths of microwaves where cavity oscillators and resonators and wave guide components become effective i e 3 mm to about 20 cm though millimeter range is of greater interest

Experimental Techniques & Equipment

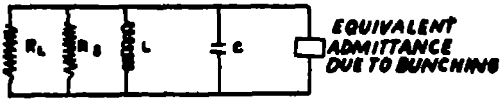
In microwave spectroscopy there is no instrument for dispersion Instead an electronically controlled oscillator is used as a source of radiation which makes possible the use of electrically tuned detector The frequency of oscillator is measured very accurately up to seven figures by the beat method The indicator is an oscillograph whose sweep is synchronized with the frequency modulation of the source thus making a visual study of the absorption pattern under study The whole set up usually consists of

(a) A source of radiation i e a frequency controlled oscillator
(b) Absorption cell with vacuum arrangements and modulating electrodes
(c) Wave guide and associated components
(d) Detecting systems

A block diagram of the arrangement is given as under (Fig 1)

In literature[1 2] can be found detailed description of microwave theory components and techniques and therefore only brief description of the various equipment and circuits used will be discussed here

(a) *Source of Radiation* — The most commonly used oscillator is the reflex klystron which operates on the principle of velocity modulation and electronic bunching An equivalent circuit diagram illustrating the principles of reflex klystron is given as below



EQUIVALENT CIRCUIT OF A REFLEX KLYSTRON

The cavity resonator and its load are represented by the parallel resistance capacitance circuit The losses are represented by R_s and the loading by R_L The bunching action produces a radio frequency current which depends on the beam current and the bunching parameter The equivalent capacitance C represents the capacity of the resonator gap the value of which can be estimated with fair degree of accuracy

Reflex klystron has only one cavity resonator which acts both as input and output circuit Also the reflector electrode is operated at a potential negative with respect to cathode Electrons which have passed

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* Now at the National Physical Laboratory New Delhi

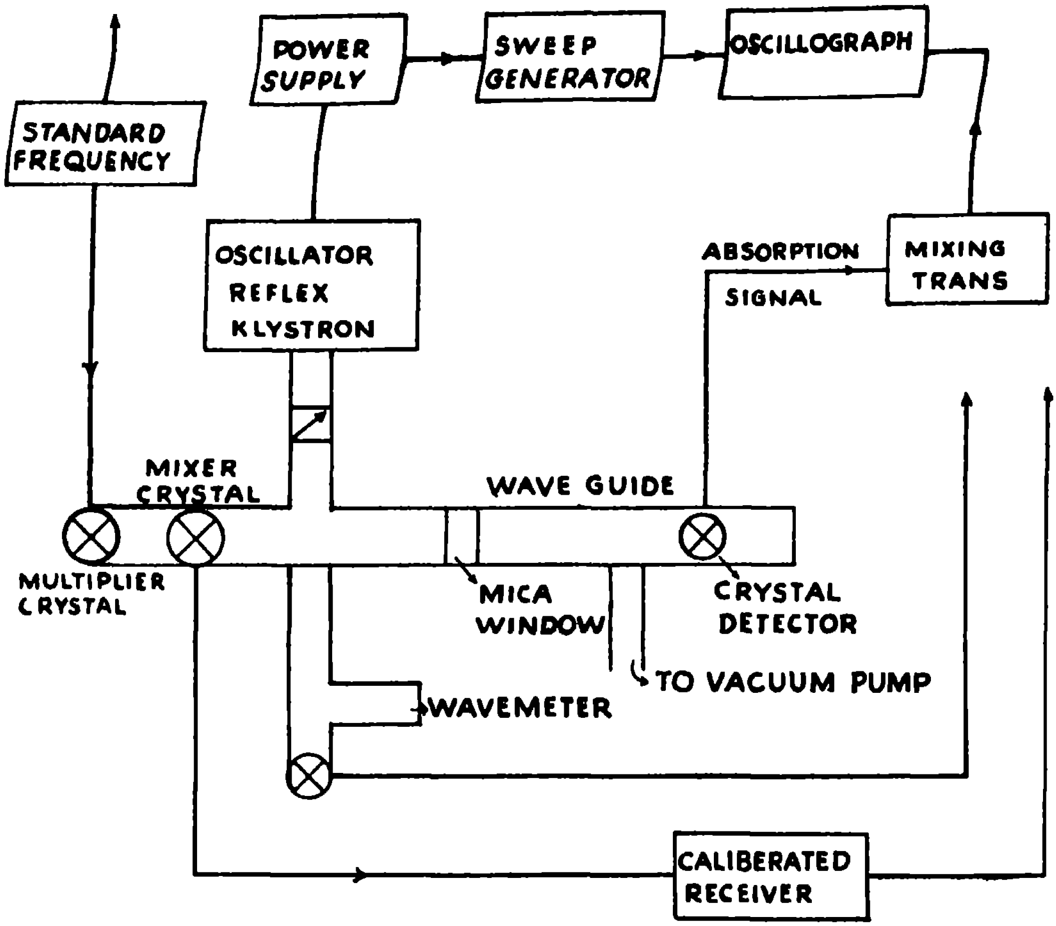

Fig 1 — Block diagram of a microwave spectrometer

through the r f gap are therefore subjected to the retarding electric field which reverses their motion before they reach the reflector and returns them through r f gap in such a phase as to give up energy to the oscillating field at the cavity Frequency characteristic of the reflex oscillator is given as

$$\tan \varnothing = 2Q \frac{(f_0 - f)}{f_0} \qquad (1)$$

where Ø is the transit angle
Q includes the effect of loading
f = frequency of oscillation
f_0 = its value at the centre of the node

Another great advantage in using a reflex klystron is the ease with which simple types of modulation e g square wave amplitude modulation or saw tooth frequency modulation can be obtained at any desired rate and over any frequency range from a few kilocycles to 40 megacycles by simply modulating the reflector voltage of the klystron Such oscillators can be obtained to cover a range of 5 mm to 20 cm Small output varying from 150 microwatts to 20 milliwatts from these oscillators is an advantage rather than a disadvantage as powers of higher order produce saturation effect in the absorbing gases as well as detecting crystals Hence magnetron oscillators are not used now though the first microwave absorption work was done using split magnetron by Clecton and Williams[3] For regions below 5 mm crystal harmonic generators have been used at Duke University by Gordy[4] and his group Electronically controlled power supplies are used in all these circuits

Frequency of the oscillator is stabilized by the Pound[6] method with an external cavity resonator at high Q and some other means for frequency conversion A block diagram is given below

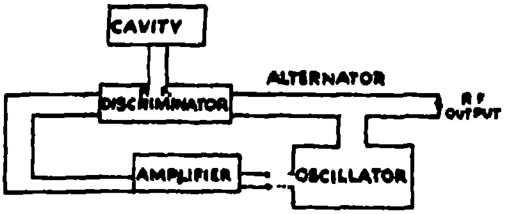

DIAGRAM OF A FREQUENCY STABILIZATION

A standard signal applied to this microwave circuit produces an output voltage which, with the resonant frequency of the cavity, produces an " error voltage " which is then amplified and super-imposed upon the supply voltage of an element of the oscillator, the potential of which controls the oscillator frequency For the stabilization circuit, it is essential that the output voltage from the amplifier have the inverse phase to that impressed upon the control element of the oscillator

Absorption Cell — Absorption cells are most frequently made from sections of rectangular wave-guides with thin mica window to seal the cells Some workers have used S-band guide (3″×1½″) very effectively for absorption cells in the region from 3 to 5 mm The absorption of gas in wave-guide cell is greater than that in a free space cell of equal length by a factor

$$\frac{\lambda_g}{\lambda}$$

where λ is the wavelength in vacuum and λ_g the wavelength in the guide given as

$$\lambda_g = \frac{\lambda}{\left[1-\left(\frac{\lambda}{\lambda_c}\right)^2\right]^{\frac{1}{2}}} \quad . \ \dots\ . (2)$$

λ_c is the cut off wavelength and is given as

$$\lambda_c = \frac{2}{\sqrt{\left(\frac{m^2}{a}\right)+\left(\frac{n}{b}\right)^2}} \quad . \ \dots\dots \quad (3)$$

where a and b are dimensions of the guide and m and n are the integers denoting the node. Hershberger[6] uses a similar rectangular guide 300 ft. section made vacuum tight with mica windows.

The attenuation for the dominant TE_o1 mode of a rectangular silver guide in terms of its smaller and larger dimensions " a " and " b " and wavelength λ is given as

$$\alpha_o = 0\ 142b^{-1}\left[\left(\frac{b}{2a}\right)\left(\frac{2b}{\lambda}\right)^2+1\right]$$
$$\times\left[\left(\frac{2b}{\lambda^2}\right)-\left(\frac{2b}{\lambda}\right)^{-\frac{1}{2}}\right] \text{ db per meter } (4)$$

Auxiliary components include a standing wave detector, tuners to eliminate a standing wave, pressure gauges, a liner amplifier and an output voltmeter Resonant cavities are also used and effective absorbing path in a resonant cavity is of the order of

$$\frac{\lambda^2}{\pi\lambda_g} Q_L$$

These cavities are specially suited for studies of Zeeman effect because the magnetic field can be applied easily

Detecting Devices — Before describing a few detecting devices, it is worth while to discuss the minimum detectable absorption According to Hershberger[7] minimum detectable power is given as

$$\Delta P = \left[\frac{4K\ T\ F\ \ \Delta f}{P_o/e}\right] \alpha_c \quad \dots\ \dots (5)$$

where α_c = attenuation coefficient,
K = Boltzman constant,
T = temperature in absolute,
F = noise figure of the receiver,
Δf = band width of the receiver, and
P /e = available power at the receiver

Hershberger has taken only Johnson noise into consideration and has ignored other types of noise considerations, e g shot noise and partition noise Gordy has suggested that in order to obtain the optimum cell length and the minimum detectable absorption coefficient of gas with a super-heterodyne receiver, one must maximize the detected power (ΔP^1) rather than the absorbed power P He gives

$$\Delta P^1 = \left\{ P_i \exp\left(-\frac{\alpha_o \rho}{4}\right) \left(\alpha_g \cdot \rho\right)^2 \right\} \quad \dots\ \dots\ \dots (6)$$

where α_g = absorption coefficient of the gas,
α_o = attenuation coefficient of the cell ; and
α = length of the cell.

With values of $\alpha_0 = 5\times10^{4}$ nepers/cm
$P = 10^{-5}$ watts
$f = 300$ c p s
$F = 40$
Value of length $l = 40$ meters

In order to improve the sensitivity of the detector Hughes and Wilson[8] have employed a stark modulation method in a relatively short section with very good results In this method the position of the absorption line is itself varied sinusoidally by means of low radio frequency In the case of ammonia (3 3) line the shift is approximately 15 mc /s for a field of 1 400 volts per cm and the shift follows the square law Expression for the wave field component H is given as

$$H = H_0 \left(1 + k \cos 2\,pt\right) \cos \omega t \tag{7}$$

where k is the modulation factor

In addition to increasing sensitivity by avoiding low frequency noise this ingenious method also completely eliminates the troublesome problem of spurious signals arising from mismatch in the microwave line Hence the problem of measuring the absorption coefficient of gas involves simply the simultaneous measurement of the average received power and modulation factor k A similar system has been used by Gordy and Kessler[9] In their method the klystron frequency is swept 20 mc /s at 60 cycles rate and simultaneously swept perhaps 40 kc /s at 100 c /s rate a 100 kc /s receiver follows the microwave detector In this case the problem of detecting and measuring an absorption coefficient involves in noting the change in power as a function of frequency fed through a microwave transmission path containing gas as the spectrum line which acts as a discriminator and converts frequency modulation into intensity modulation

Super heterodyne is found not to be superior in sensitivity to simple Video receiver operating with a square law detector because in microwave spectroscopy small changes of power are to be detected Hence a rather more sensitive microwave spectrograph can be made by employing the frequency sweep method with a crystal Video receiver Very narrow band audio amplifiers are used Somethimes a double-crystal balanced Video receiver is used for detection

The most direct method of determining the overall sensitivity of a microwave spectroscope is the measurement of the signal to noise ratio obtainable for weak spectral lines of known absorption coefficient Thermocouples and bolometers are also used some times but they are not so sensitive for detecting sub microvolt power in the micro wave region

Frequency Measurements — One of the advantages of microwave spectroscopy over optical spectroscopy is the degree of accuracy attainable in the measurement of the frequency of the oscillator For regions above 1 cm wavelength a number of cavity wave meters have been designed with accuracies of about ± 3 mc /s The co axial type is self calibrating and can be made to tune over a very wide frequency range The frequencies of different modes of a cylindrical cavity are given by the formula

$$f = \frac{c}{2}\left[\left(\frac{2\,x\,l_m}{\pi\,D}\right)^{2} + \left(\frac{n}{l}\right)^{2}\right]^{\frac{1}{2}} \tag{8}$$

where c is the velocity of light D and L are diameter and length of the cylinder

For more accurate measurements a standard signal of 10 mc /s is taken from W W V this 10 mc /s multiplied to 270 mc /s and then to 2 970 mc /s which is again multiplied by crystals to the desired 5 mm range The crystal is also modulated by 270 mc /s power and by some of 90 mc /s power which is made to bypass the klystron the side band frequencies thus produced provide markers which cover the microwave region at 90 mc /s intervals Using a communication receiver and applying frequency sweep method it is easy by mixing the two signals to super impose the pip from the receiver upon the absorption line appearing on the oscilloscope Cavity wave meters are used to check the markers Workable energy can be obtained at least to 20th harmonic of the klystron frequency of 2 970 mc /s hence measurements can be extended up to 5 mm or so Using this method spectral lines can be measured to an accuracy of about 50 kc /s at 25 000 mc /s

The experimental difficulties in obtaining atomic spectra in microwave regions are great hence only two investigations have been reported so far One is the observation of hyperfine structure of cesium by Roberts Beers and Hill[10] and the other the famous hydrogen experiment of Lamb and Rutherford[11] Roberts Beers and Hill observed directly the hyperfine structure in the 3 cm wave region of cesium vapour They were able to measure 14 to 15 components of cesium transition by introducing a micro gram of cesium vapour at 4×10^{2} mm pressure into the frequency controlling resonant cavity of a stabilized oscillator near 9 192 6 mc /s and observing the 30 c p s component of the audio signal detected by an f m receiver when a weak external magnetic field in the cavity is modulated at 30 c p s

Lamb and Rutherford s experiment is of great importance as it gave the first experimental disagreement with Dirac s quantum electrodynamic theory according to which the levels of the same n and j should be degenerate They used the atomic or molecular beam technique developed by Rabi Zacharia Milliman and Kusch at Columbia University

When the atoms in meta stable state $^{2}S_{\frac{1}{2}}$ are passed through weak microwave radiation of the correct gyrofrequency which is about 1000 mc /s some are raised to $^{2}P_{\frac{1}{2}}$ state from which they decay to $^{1}S_{\frac{1}{2}}$ state and at this frequency a dip is observed Bethe[13] has shown that this anomaly may be due to the interaction of the electron with the electromagnetic radiation field and he predicted a shift of 1 050 mc /s This prediction has actually been experimentally verified by Fowles[13] in the optical spectra of the ionized helium

Absorption Spectra of Gases & Vapours

One of the most thoroughly investigated spectra is the inversion spectrum of ammonia The absorption of 1 25 cm waves by ammonia gas has been known for sometimes and is so intense that a plane 1 25 cm wave loses half its power on traversing a 3 layer of ammonia at N T P Besides ammonia a number of gases were found by Hershberger and others[6] to be strong absorbers of microwaves at room temperature They also found that microwave energy was converted into heat and sound directly Also Van Vleck[14] pointed out that the absorption of 6 mm waves by oxygen and 1 3 cm waves by water vapour is so large as to limit severely the use of these wave lengths in communication and radar

Ammonia absorbs microwaves due to its capacity for turning inside out The two equilibrium positions of the nitrogen on either side of the plane defined by 3 hydrogens are separated by a potential barrier which nitrogen tunnels through The inversion spectrum consists of a number of different lines arising from molecules in different rotational states

The potential barrier involved in the so called tunnel effect is so low that the energy levels of the molecules are measurably split Pressure broadening i e the broadening of spectral line that arises from collisions between molecules necessitates working at very low pressure if we wish to observe a spectral line at low radio frequency All of the molecules which are found to absorb possess either an electric or a magnetic dipole moment which serves to couple them to the applied electromagnetic field

Sheng Barker and Dennison[15] gave the theoretical explanation and formula for the fine structure of inversion spectrum of ammonia which is given below

$$\nu = \nu_{0} - 0\,0011\,J\,(J+1) + 0\,0016\,K^{2} \qquad (9)$$

Howe was first to detect this fine structure and Good[16] and Bleaney and Penrose[17] observed as many as 30 lines in the inversion spectrum of ammonia Good found that at pressure of 10^{2} mm Hg and below a definite hyperfine structure appears due to interaction of the nuclear quadruple moment of N^{14} with molecular field Also a definite frequency shift of the various lines was observed when a d c field was applied to the absorbing gas For greater accuracy a fourth power formula has been employed by Simmons and Gordy[18] to calculate the fine structure of NH_3 inversion spectrum The Van Vleck Weisskopf formula[19] when modified for ammonia inversion spectrum becomes as

$$\alpha = 18\nu^{2}\left[K^{2}\frac{(2J+1)}{J(J+1)}\right]g \exp\left[-0\,0475J\,(J+1) + 0\,0174K^{2}\right] \qquad (10)$$

Simmons and Gordy attribute the hyperfine structure also due to interaction of the nuclear magnetic moment of nitrogen with the magnetic field arising from molecular rotation in addition to the nuclear quadruple interaction with molecular field

Rotational Spectra

Iodine monochloride is the only diatomic molecule whose pure rotational spectrum has been investigated in the microwave region by Weidner[20] Rotational frequencies of diatomic molecules are given by the following approximate formula

$$\nu = 2B(J+1) - 4D(J+1)^3 \qquad (11)$$

where J = 0 1 2 3

$$B = \frac{h}{8\pi^2 cI}$$

$$D = \frac{4B^3}{\omega^2}$$

I is the moment of inertia and ω is the fundamental vibration frequency Rotational spectra of diatomic molecules have been used to determine the mass ratios of different isotopes Frequency difference in the corresponding isotopic frequencies for the ground vibrational state[22] is

$$\begin{aligned}\Delta\nu &= \nu_r - \nu_r{}^{i} \\ &= 2B_e(J+1)(1-\rho^2) - \alpha_e \\ &\quad (1-\rho^3)(J+1) - 4D \\ &\quad (1-\rho^4)(J+1)^3 \qquad (12)\end{aligned}$$

Where Be e D refer to the isotope corresponding to ν_r and $\rho = \left(\frac{\mu}{\mu_i}\right)^{\frac{1}{2}}$ mass ratio which can be determined Townes Merritt Wright[21] have evaluated the mass ratio of Cl^{35}/Cl^{37} which agrees well with Aston s values

Similar method is used for determining the mass ratio in optical band spectroscopy but as the resolving power in microwave spectroscopy is so much higher much more precise values are obtained As a result of the interaction between vibration and rotation a doubling of rotational lines termed ρ type doubling occurs for degenerate bending The separation of the doubled line is given as

$$\Delta\nu = 2q(J+1) \qquad (13)$$

where q is a small constant

The microwave rotation spectra of a number of symmetric top molecules have been investigated theoretically and experimentally In Herzberg notation rotational frequencies are given by Slawasky and Dennison equation as

$$\begin{aligned}\nu = 2B(J+1) &- 4D_J(J+1)^3 \\ &- 2D(J+1)K^2 \qquad (14)\end{aligned}$$

where $B = \frac{h}{8\pi^2 I_{BC}}$

By employing molecules with different isotopes complete determination of molecular structures have been made in certain cases like methyl halides which was not possible either by electron diffraction methods of infra red spectroscopy This was made possible by using Johnson and Dennison[23] equation given below

$$\Sigma\Delta\nu_s = \left\{\left[\frac{6}{I_A} - \frac{7}{I_B}\right]\frac{h}{8\pi^2 c}\right\} \qquad (15)$$

It is easy to determine I_A when accurate values of I_B had already been determined from microwave rotation spectra It was found that C H distances are not the same in these molecules but vary in a uniform manner from F to I Similar works are being carried on with other molecules

So far only two complete structural determinations of asymmetric top molecules have been determined by microwave spectroscopy These are SO_2 and HNCS In the case of asymmetric top molecules all the moments of inertia can be determined by pure rotation spectra alone the structure of triatomic molecules can be determined without using different isotopic combinations Rotational energies by asymmetric top molecules have been calculated by King Hainer and Cross[20] by the following simplified equation

$$\begin{aligned}\frac{E_r}{hc} &= \tfrac{1}{2}(A+C)J(J+1) \\ &\quad + \tfrac{1}{2}(A-C)L_r \qquad (16)\end{aligned}$$

where $A = \frac{h}{8\pi^2 cI_A}$

$$B = \frac{h}{8\pi^2 c\, I}$$

$$C = \frac{h}{8\pi^2 cI_C}$$

I_A I_B I_C are the three moments of inertia

These authors have also constructed tables which allow easy calculations of the line intensities of asymmetric rotators No free internal rotational spectra have so far been reported in the microwave region

Stark Effect

The use of Stark modulation for detecting weak lines has been given earlier Since the last 20 years the theory of Stark effect in rotational spectra has been developed by Debye but its application was made possible with the coming of microwave spectroscopy The Stark effect in several linear molecules has now been investigated and dipole moments determined by using the equation for the second order rotational energy perturbation for the ground vibrational state which is given as

$$W_{J\mu} = \left[\frac{4\pi^2 \mu E^2 I}{h^2} \right] \left[\frac{J(J+1) - 3M^2}{J(J+1)(2J-1)(2J+3)} \right] \quad (17)$$

where E = strength of the applied electronic field
μ = molecular dipole moment
and
$M = J \quad J \, 1 \quad 0$

The treatment of the symmetric top molecule is similar but has first order effects as well Stark effect in symmetric top molecules has not been studied so far

Zeeman Effect

Zeeman effect in microwave spectroscopy is quite analogous to the nuclear Zeeman effect in atomic spectra and the equation giving magnetic interaction term as found by Jen[34] is similar to the formula of Back and Goudsmit for Zeeman effects in the hyperfine structure of the atoms The interaction term is

$$\Delta W = M \mu_0 H (\alpha_J g_{mol} + \alpha_I g_N) \quad (18)$$

where $\alpha_J = F(F+1) + J(J+1) - I(I+1)$

$$\alpha_I = \frac{F(F+1) + I(I+1) - J(J+1)}{2F(F+1)}$$

$M = F \quad F\,1 \quad F\,2 \qquad F$
μ_0 = nuclear magnetron
g_{mol} = g factor for the molecule along J
g_N = g factorof the nucleus considered
and
H = external mag field

With a field of 1 670 gauss Jen detected a broadening of the rotational lines in SO_2 but perhaps the magnetic field was not enough to split it When $g_{mol} = 0$ interesting splitting terms are obtained in the case of CH_3Cl^{35} as observed by Jen[34] This method can be used for determining unknown magnetic moments NH_3 CH_3Cl SO_2 are the only molecules investigated so far but Zeeman effect in microwave spectroscopy promises to be a subject of important research

Applications

In nuclear physics microwave spectroscopy has been employed for precise determination of nuclear couplings dipole moments quadruple moments and nuclear spins The values of nuclear spin as determined by the microwave spectroscopy and atomic beam method are more reliable than those determined by the hyperfine structure of Zeeman effect Also this method may prove extremely valuable for determination of the spins of radioactive or rare nuclei

Microwaves have also been used for the study of the dipole moments of several liquids including nitrobenzene acetone methyl cyanide etc by measuring the frequency of maximum absorption or relaxation time In addition to the possibilities of microwave resonant frequencies in solids there exists the chance of resonant absorption in certain liquids or solutions arising from vibrations in molecular chains held together by weak intermolecular bonds such as hydrogen bonds Also the magnetic resonance absorption of solids in the microwave region provides a new and powerful means of measuring closely spaced energy levels in paramagnetic substances and studying the structures of certain crystals Microwave spectroscopy is being used for the study of molecular structure and isotopic mass ratio determinations with much greater accuracy than is possible by the method of infra red spectroscopy

One of the most important applications of microwave spectroscopy is in the field of frequency stabilization at microwave frequencies Molecular spectral lines possess two properties which make them particularly suitable for use in frequency control work and also as frequency standards The first is the constancy of the mid frequency of the absorption line like the constancy of spectral lines in optical spectroscopy and the second is the very high Q value of the ammonia line which is of the order of 1 00 000 at a pressure of 10^{-5} mm and ordinary temperatures i e 300°T One of the common methods of stabilization consists of employing interaction at the microwave frequency between the high Q absorbing gas and klystron oscillator similar to the interaction between a quartz crystal and its associated amplifier The arrangement is a feed back or servo mechanism arrangement in which an error voltage is fed back to the oscillator under control to maintain equality between the ammonia absorption frequency and the klystron frequency This stable ammonia absorption line is being used to control a crystal clock at the National Bureau of Standards The ammonia gas molecules, which vibrate at 24,000 mc/s, regulate a standard quartz crystal clock The difference or error vibrations of ammonia and quartz is electronically developed and keeps the quartz clock locked to the ammonia frequency

Also another "atomic clock" is under construction in which the vibrations of cesium atoms are being used in an atomic beam technique This cesium clock has the highest potential accuracy of time, i e 21 sec in one hundred years! Such a clock will have important applications in microwave communication, molecular structure and astronomy

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Bibliography of Scientific Publications, South Asia

The Bibliography published by the UNESCO Science Co-operation Office for South Asia, Delhi, is the first compilation of the kind ever attempted The inaugural number recently published covers the period January to June 1949, and relates to scientific literature published in India, Burma and Ceylon A separate series will be issued for other South Asian countries

All branches of sciences, pure and applied, are included Special attention is given to papers reporting original research, though review articles and new ideas are also included The first few pages give a list of periodicals complete with subscription rates and addresses

The UNESCO Science Co-operation Office maintains notes of addresses of authors and editors and of libraries where particular articles can be found Scientists are invited to use the facilities to obtain reprints, microfilm or photostat copies Short résumés of articles listed in the bibliography can be had from the Office on request

This compilation listing the titles of scientific contributions of particular region fulfils a pressing need and facilitates exchange of scientific information and ideas between working scientists

The Colouring of Foodstuffs

THE use of synthetic colouring matters in the preparation of manufactured and preserved foodstuffs has now become a widespread and established practice It is no longer regarded with suspicion but, on the contrary, is recognized as being an integral part of the processes of manufacture Natural colours frequently fade or leach out in processing and artificial colours must be added in order either to restore the original shade or to impart the popular tint The public has come to associate definite shades with certain foods and any departure from a generally accepted shade is construed as an alteration in the product itself, with the ensuing possibility of complaints to the manufacturer and an immediate falling-off in his sales The public demands that its butter shall be yellow, that its strawberry jam shall be red, that its jellies shall be suggestive of the fruits from which they have been made, and so on Foodstuffs must appeal to the eye before being accepted by the palate

We must not lose sight of this psychological aspect The satisfactory physical appearance of many cooked and preserved foods can only be restored by the addition of artificial colouring matters and it becomes necessary for the food manufacturer to acquaint himself with the elementary principles controlling the use of such agents and with their properties and characteristics The correct colouring of foodstuffs is a science as well as an art At one time it was treated with unnecessary reticence by both the colour manufacturer and the colour user and in consequence the interests of each and of the public suffered It must be emphasized here that the complications arising from the use of colouring matters are so many, the reactions of the foodstuffs so varied and the applications so diverse that it is only by collaboration of these two that a satisfactory product can be presented for the approval of the public.

As the foodstuff manufacturer in most cases has to rely on the dye-maker for purity and quality of colours, ultimately, therefore, it is the responsibility of the dye-maker to ensure that the products used for colouring foods are harmless There are many problems in connection with the performance of a colouring matter in food products, high fastness to heat is demanded by bakers and boiled sweet-makers, in many foods the colour must be unaffected by the preservative present, in fruit-canning the hue must be unaffected by fruit acids, colours for mineral waters must possess a fairly high light fastness The solubility characteristics also are important as undissolved specks of colour would mar the appearance of clear boiled sweets or delicately coloured custard powders or other corn-flour preparations

A malpractice which has been prevalent for many years and which still exists to some extent is the dilution of colours with inert materials in order to reduce their apparent toxicity The dilution of colours to specific strengths is recognized as being necessary to ensure standardization and is not normally regarded as being to the disadvantage of the consumer This practice becomes an abuse, however, when the colouring matter is excessively diluted with the sole object of bringing its content of toxic materials down to an apparently low level, thus enabling the supplier to give a guarantee of suitability for foodstuff purposes Such a practice is strongly to be condemned as the consumer must then use a correspondingly larger amount of colour to tint the foodstuff to the required shade and the toxic content of the finished goods is the same as would be obtained if the undiluted, impure dyestuff were used Not only should colouring matters contain minimum amounts of toxic materials, but this minimum must be attained by careful manufacture and not by a process of dilution

The food laws put the responsibility for the colours used largely on the foodstuff manufacturer According to the Food and Drugs Act passed in the U K in 1938 " no person shall add any substance to any food so as to render the food injurious to health "

No comprehensive legislation exists in India on the use of colouring matter in foods As early as 1930, the Government of the United Provinces had made certain provisions for the use of artificial colours in foods in the rules framed under their Food Adulteration Act Two lists of colouring matters were given one of colours which could be used and the second of those which were prohibited (APPENDIX A) These rules were recommended for acceptance by the Ministry of Health to the various Provincial Governments in 1947 Subsequently in August 1948 the Ministry of Health Government of India brought to the notice of the Provincial Governments the rules adopted under the New Zealand Food & Drugs Regulations 1946 The list (APPENDIX B) included names of 28 synthetic colours which could be incorporated in foods

A joint meeting of the Food Standards Committee of the Technical Panel in the Ministry of Food and the Central Committee for Food Standards in the Ministry of Health was convened in March 1950 under the Chairmanship of Dr K Mitra Adviser in Nutrition Directorate General of Health Services Delhi to find out as to what could be done to check the increasing use of colours in *foodstuffs* — colours which were reported to be injurious to health

The recommendations made by the Committee prohibit the use of inorganic colouring matters and pigments in all foods and permit a restricted use of certain synthetic and organic dyes a tentative list (APPENDIX C) of which has been drawn up The Committee however agreed that the incorporation of such vegetable colouring matters or pigments occurring in edible fruits or vegetables should be permitted Plans for the setting up of an active organization to implement and enforce these recommendations are under consideration

Reputable dyestuff manufacturers have on the market brands of colours for food stuffs (e g the Edicol range of *Imperial Chemical Industries Ltd*) which are sold with a guarantee according to the particular food laws to which they conform

APPENDIX A

EXTRACTS FROM UNITED PROVINCES PUBLIC HEALTH (PREVENTION ETC IN FOOD) RULES 1930

Colouring matters which may not be added to articles of food

1 *Metallic Colouring Matters* — Compounds of any of the following metals antimony cadmium copper lead arsenic chromium mercury zinc

2 *Vegetable Colouring Matter* — Gamboge

3 *Coal-tar Colours*

No in colour index of Society of Dyers & Colourists 1924	*Name*	*Synonyms*
7	Picric acid	Carbazotic acid
8	Victoria yellow	Saffron substitutes dinitrocresol
9	Manchester yellow	Napthol yellow Martius yellow
12	Aurantia	Imperial yellow
724	Aurine	Resolic acid yellow coralline

Colouring matters which may be added to articles of food

Red shades	80	Ponceau 3 R
	187	Amaranth
	773	Erythrosine
Orange shade	150	Orange I
Yellow shades	10	Napthol Yellow S
	640	Tartazine
	22	Yellow AB
	61	Yellow OB
Green shades	666	Guinea Green B
	670	Light Green SF Yellowish Fast Green F CF P hydroxy derivative of the sodium salt of alpha zurine F G CI 671
Blue shade	1180	Indigo Disulpho Acid

The numbers preceding the names refer to the numbers of the colours as listed in the Colour Index published in 1924 by the Society of Dyers and Colourists of Great Britain

APPENDIX B

EXTRACTS FROM NEW ZEALAND FOOD & DRUGS REGULATIONS 1946

The following shall be deemed to be harmless colouring substances satisfying the regulations

(a) Caramel (prepared solely from sugar)
(b) Cochineal
(c) Chlorophyll
(d) Saffron
(e) Every harmless vegetable colour

(f) The following synthetic colouring substances, namely .

Red Shades —
79 Ponceau 2 R
80 Ponceau 3 R
— Ponceau SX
179 Carmoisine, Cardinal 3 B
184 Amaranth, Brilliant Bordeaux B
185 Brilliant Scarlet 4 R, Brilliant Ponceau 5 R
225 Chlorazol Pink Y, Direct Thio Red
749 Rhodamine B
773 Erythrosine
448 Benzopurpurine 4 B for colouring sausage skins only

Orange Shades —
26 Croceine Orange
150 Orange I
— Orange SS

Yellow Shades —
10 Napthol Yellow S
16 Acid Yellow G Kond
22 Yellow AB
61 Yellow OB
640 Tartar Yellow, Tartrazine, Tartratol Yellow L
— Sunset Yellow FCF

Green Shades —
666 Acid Green G, Guinea Green B
670 Light Green SF Yellowish
— Fast Green FCF

Blue Shades —
671 Brilliant Blue FCF (Sodium salt)
1180 Indigo Carmine

Violet Shade —
698 Acid Violet 5 BN

Brown Shades —
— Certicol Brown RS, Edicol Chocolate NS
— Golden Brown 34832, Edicol Brown OHS

Black Shade —
865 Nigrosine

The numbers in the margin opposite the names of the synthetic colouring substances under (f) of this regulation refer to the numbers allotted in Rowe's Colour Index (edited by F M Rowe and published in 1924 by the Society of Dyers and Colourists, England)

APPENDIX C

Brilliant Blue FCF
Indigotine
Guinea Green B
Light Green SF Yellowish
Fast Green FCF
Orange I
Orange SS
Ponceau 3R
Amaranth
Erythrosine
Ponceau SX
Oil Red XO
Napthol Yellow S
Napthol Yellow S — Potassium Salt
Yellow AB
Yellow OB
Tartrazine
Sunset Yellow FCF

The dyes from the above list when used in foodstuffs should be absolutely pure and free from any harmful impurities The maximum limit permissible for each of the dyes should be fixed at one grain for each pound of food

REVIEWS

Physical Principles of Oil Production, by Morris Muskat (McGraw-Hill Book Co Inc), International Series in Pure & Applied Physics, 1949, pp xv + 922 Price not indicated

OIL IS PRODUCED FROM WELLS DRILLED INTO underground oil reservoirs, which are formed in porous sedimentary rock formations like sandstones, limestones or dolomites, which have at one time taken in and trapped the oil in their pores The oil is initially at a higher temperature and pressure, depending on the depth and the other environmental factors of the reservoir Oil reservoirs are sealed in and limited by the surrounding impermeable rocks, or even by partially permeable rocks containing water, the water-oil interface in the capillary pore spaces acting as the sealing blanket Oil reservoirs are usually closed by local deformations of strata such as a simple folding into closed anticlines or domes

As an essential preliminary, suitable tests on core samples of the oil-bearing rocks should be conducted to accurately estimate such factors as their porosity, permeability and fluid content Test data so obtained should be statistically studied and correctly interpreted The hydrodynamics of the fluid movements within the rock strata and into the oil wells should be thoroughly understood The bearing of possible anisotropy in reservoir permeability on the problem of fluid flow should also be investigated Moreover, the fluid itself can be a mixture of many ingredients both in the liquid and gaseous phases The effects of that heterogeneity in the composition of the flowing liquid should also be assessed The initial chapters of the book are devoted to a general study of such topics The treatment favours the usual text-book method, and each problem is treated proposition by proposition, with assumptions of idealized initial conditions of progressively increasing complexities But, as the author himself says in the preface, the book is not meant to be " a text-book of a particular grade or level, and directed to a particular class of reader "

The general performance of an oil-producing reservoir is determined by the nature of the energy available for oil expulsion, and the manner in which that energy is made to operate The oil can, of course, be moved into the well-bore and out of it by virtue of the initial oil pressure itself, but that can be effective only during the starting phases of production, and will become of minor importance at later stages The major potential source of oil expulsion energy is the pressure exerted by the gas dissolved in the oil itself or present in the free state in the gas-cap above Oil withdrawal is then said to be through " solution-gas drive " or " gas-cap-expansion drive " mechanisms Oil is also expelled from a reservoir through displacement, by water entering the oil pay The withdrawal is then said to be through a " water-drive " mechanism which may be of two kinds — a " side-water drive " brought about by a lateral edge-water encroachment, or " bottom-water drive " effected by an uprise of water from the bottom layers Between the strict gas-drive and the complete water-drive mechanisms lie a series of intermediate gas-water combination drives The general mechanics of these different drives are developed and studied in the book with a view to obtaining an insight into the methods of production control, so as to conserve the energy of expulsion, and to realize a significant retardation in the pressure decline and thereby to assure the maximum possible percentage of oil recovery from the reservoir.

On a conservative estimate, the quantity of oil still left in the reservoir, after it has been abandoned as uneconomical, works out to be about equal to the quantity of oil withdrawn previously The methods of oil production thus appear at first to be inherently wasteful and inefficient Intelligent primary control minimizes the residual oil left behind, but an appreciable quantity of oil is always available for further recovery Also there had been a large number of wells worked and abandoned before such control methods were sufficiently well understood Secondary recovery methods are adopted in such cases for reclaiming the residual oil They consist in the injection of gas or water through an interlaced network distribution of injection and production well bores or in a general " water-flooding " The mechanics of such secondary recovery systems are well discussed in the book Experimental technique for studying visually through scale models the behaviour of different systems of well distribution like line drives five spot and hexagonal networks are described in the book with appropriate illustrations though one would like greater stress placed on the essential three-dimensional nature of the problem

One chapter is devoted to " condensate reservoirs " wherein when the pressure is released in the well-bore, a condensate or distillate is initially recovered But side by side with this recovery is a retrograde condensation of the saturated vapour back into the reservoir itself In such cases an injection of the produced dry gas freed of liquefiable contents a pressure maintenance operation known as ' cycling is resorted to, partly as a method of prevention of this retrograde condensation and partly as a method of ultimate recovery of the condensed oil itself Geometrical patterns of bore-wells to facilitate such cycling " processes and the experimental studies through models, of their characteristics and behaviour are described at length in the book

The book thus covers practically all problems of oil-reservoir engineering The treatment is essentially theoretical and based on idealized and simplified assumptions Though, here and there, practical data from a few important oil wells are given and discussed, no sustained attempt is made to effectively connect up the theoretical study with the practical aspects of oil production The author himself says that his aim is only to give the underlying physics and mechanics of oil reservoir problems All the significant and relevant matter have been brought together and presented so as to afford a complete picture of the scientific basis of oil-well technology The book is a valuable exposition of an important subject which is still in a stage of active development In addition to those who are actively interested in this particular subject, this book will be found useful to all specializing in the study of underground water movement and general physics of fluid flow through granular beds The printing and get-up of the book are up to the well-known standards of McGraw-Hill publications

T N SESHADRI

Bibliography of Research on Heavy Hydrogen Compounds (National Nuclear Energy Series) compiled by Alic H Kimball & edited by Harold C Urey & Isidor Kirshenbaum (McGraw-Hill Book Co Inc New York Toronto London), 1949 1st Edition pp 350 Price $ 3 26

DEUTERIUM THE STABLE HEAVY ISOTOPE of hydrogen was discovered in the year 1931 and since its discovery it has been the object of intensive research study because of its extensive use as a tracer in chemical and biological reactions in testing theories where mass effects were involved and its application as a moderator in atomic piles As a result of these research studies conducted in every country a very large number of articles dealing with the physical and chemical properties of deuterium and its compounds have been published in various scientific periodicals

The volume under review is a compilation of references to the existing literature on deuterium and its compounds The references are classified and arranged subject-wise for ready reference This work should therefore be welcomed by any research worker who wishes to survey the bibliography of the past achievements in this field

SWAMI JNANANANDA

The Indian Cotton Textile Industry (1949 Annual), by M P Gandhi (Gandhi & Co Bombay), 1949, pp liv + 174 + xxxi Price Rs 6

THE WHOLE WORK IS CHARACTERIZED BY clear-thinking and scientific analysis The book contains a great deal of statistical data and is a storehouse of information on cotton textile industry in India in its various aspects, viz production, price, finance, distribution, import, export, labour and textile machinery manufacturing It is a valuable addition to cotton literature and will be found useful alike by students business men financiers and government officials

It is however suggested that for easy reference a book of this description may include a few maps to indicate at a glance the location of mills areas of raw cotton production etc and other important facts

K N

“**Analar Standards for Laboratory Chemicals** (formulated and issued jointly by the British Drug Houses Ltd and Hopkin & Williams Ltd London) 4th Edition 1949 pp 302 + xviii

THE ANALYTICAL CHEMIST HAS BEEN LOOKING forward keenly from 1944 to a new edition of Analar standards extending the specifications for more reagents required for his work The 4th edition of the Analar standards under review has amply justified the expectations in that specifications for 58 new Analar chemicals have been included Of the new additions the most welcome inclusions are some of the organic reagents used in micro organic analysis and some important reagents for the identification of organic compounds The only omission in the present edition from the previous one is ferric chloride and that is perfectly justifiable

Besides extending its usefulness on the quantitative side the present edition has got some special features which are very valuable for the analyst The following are the two notable points (i) the technique of electrolytic deposition for the assay of certain metallic salts and for the removal of principal metals from such salts in order to enable easier determination of the other impurities and (ii) the modern Karl Fischer technique for the estimation of water in organic liquids Another feature of the publication is the substitution of newer methods of assay leading to greater sensitivity and greater accuracy wherever appropriate thereby bringing down the value of maximum permissible impurities thus contributing to the preparation of better quality chemicals

The printing and get up of the book leaves nothing to be desired except for a slight mistake on p 227 under item 8 of $NaHSO$ for $NaHSO_4$ Under assay of cupric oxide on p 292 the method suggested requires a little modification as it is not usual to perform iodimetric titration of copper in the presence of hydrochloric acid or any mineral acid Usually the titration is conducted in acetic acid medium and in fact this has been suggested by the same publication for the other copper salts An alternative procedure in this case might be to dissolve the oxide in dilute phosphoric acid and then proceed as usual for iodimetric titration

It appears to the reviewer that the publication will have wider significance if a small paragraph is devoted at the beginning of each chemical as to the reasons that have prompted the publishers to choose the list of reagents for a selected chemical before giving the methods of estimation

S A C

Modern Plastics by Harry Barron (Chapman & Hall Ltd London) 2nd Edition pp xi + 779 with 272 illustrations Price 50*s* net

ONE WHO HAS TO LABOUR THROUGH THIS big volume cannot help closing the book with a feeling of disappointment wondering as to what extent it has helped in clarifying ideas or giving him a real insight into the intricacies of the subject The type of details which are recorded in this book impress upon the reader its encyclopaedic scope One notices however that the book suffers from a lack of purposiveness which has inevitably resulted in a rather incohesive and jumbled presentation of the numerous findings of modern research The uniform emphasis if any laid on all the facts and details presented in this book makes it a task for the reader to pick out the more important facts fundamental principles and processes from the relatively less important ones It may not be an exaggeration to state that precision and clarity of thought are conspicuous by their rarity

The many tables and figures which are inserted in the body of the subject matter do not fully serve their purpose Although these are numbered they are not as a rule referred to in the subject matter nor are the salient points intended to be brought out by them duly stressed The historical background of the industry which has been attempted is poorly delineated The impact of the extraordinary advances made in other fields of invention has given a forceful incentive and drive to the development of chemical processes and technological methods which are responsible for the remarkable achievements in this field. The pictures of the motor car and the aeroplane showing the various gadgets which are made from plastics are but a poor, apologetic and old-fashioned device for illustrating the immense and far-reaching applications and potentialities of plastics made possible by novel processes and ingenious techniques

The author's attempt at covering *all* about modern plastics in this volume evidently makes precise or clear-cut presentation of important topics difficult The book conveys to the reader an impression of a conglomerate of loose and approximate statements and disjointed paragraphs It contains sentences which are structurally unsound, involved and clumsy Here are a few examples

(a) *Page* 76 — " American production of alcohol for 1944 was more than 631,000,000 gallons Produced from molasses, grain, petroleum, natural gas, sulphite liquors and wood waste "

(b) *Page* 78 — " Considering both this process from the engineering point of view on a large scale, it is clear that the vaporising of alcohol is not a difficult operation nor is the passage over a catalyst "

(c) *Page* 83 — " The low cost of ingredients *have* made this plastic of interest for industrial applications involving large quantities of material such as building units, furniture and wall panelling, etc "

(d) *Page* 80 — " The cheapest wood waste is saw-dust, comprising about one-third of the total mill waste It is already in the physical form suitable for hydrolysis without further processing Therefore it has been found that the minimum mill that could operate on saw-dust alone must be three times the size of one turning all its waste into chemicals In order to support a hydrolysis plant using the American process, this mill must cut about 150,000,000 feet a year

" Seventy tons of wood per day, or a daily cut of 70,000 feet of lumber would be required to support a Scholler plant capable of producing 3,600 gallons of alcohol per day, at a yield of 50 gallons of alcohol per ton of wood. Such a mill would cut 20,000,000 feet annually. An alcohol plant of the same capacity using the American process at a yield of 20 gallons per ton of wood would require 180 tons of wood per day, the waste from a daily cut of 180,000, or roughly, an annual cut of 54,000,000 feet "

The last two paragraphs could, doubtless, be expressed more precisely in a shorter span and with better effect. Practically all the sections dealt with in this book disclose that the general approach is devoid of simplicity, clear thinking and directness of presentation The versatile uses of plastics as building materials, which the author has chosen to indicate in a pictorial manner in Fig 13 is, to say the least, queer and unnecessarily complicating

It is not easy to grasp what the author attempts to impress when one reads sentences such as the following

Page 34 — " If U S plastics consumption in 1939 is taken as 100, in 1947 cellulosic moulding materials are at 750

Phenolic Resins	300
Urea Resins	300
Melamine	300
Polystyrene	12,500
Vinyl Resins	15,000 "

It will serve no useful purpose to mention in this review the numerous chapter headings dealt with in the book, since the author's aim seems to be to describe and discuss *all* and sundry about plastics, without any attempt at judicious discrimination It will, therefore, suffice here to give the titles of the main parts of the book, viz Part I Introductory Part II Thermosetting Resins and Their Plastics Part III Cellulose Plastics Part IV Vinyl Plastics Part V Other Leading Plastics Part VI Some Important Aspects of Plastics In the last part are included chapters on High-frequency Heating for Plastics, Analytical Aspects and Physical Testing of Plastics

This is a book which may be kept on the shelves for occasional reference to get some abstruse detail, which a researcher, a factory foreman or a prospective industrialist will like to get It is not likely to be of much use to the post-graduate research worker for reason of its inadequate treatment of the basic and fundamental, theoretical and thought-provoking aspects, nor can it be safely recommended as a text-book study for the under-graduate It will serve to capture the interest of the layman who yearns to have a comprehensive view of what these " mysterious " substances, in reality, are, with their oft-mentioned ubiquitous applications.

A J.R.

Vacuum Equipment and Techniques, National Nuclear Energy Series — Manhattan Project Tech Section edited by A Guthrie & R K Wakerling (McGraw Hill Book Co Inc New York Toronto London) 1949 1st Edition pp 264 Price 25s

HIGH VACUA ARE ESSENTIAL REQUISITES FOR pure research in many branches of modern physics and chemical engineering Without high vacua certain types of production engineering such as manufacture of incandescent lamps radio valves X ray tubes etc would not have been possible The development of atomic power engineering has been rendered possible only by the application of high vacua Thus modern physical and chemical laboratories production engineering plants and atomic power engineering works are constantly confronted with problems of the technique of production of high vacua measurement of pressures of high vacua and the construction of vacuum equipment for various purposes A study of these problems therefore has become an essential necessity both for the research scientist and the production engineer

There are already excellent treatises monographs and articles dealing with principles production measurement and techniques of high vacua The work under review *Vacuum Equipment and Techniques* does not propose to compete or supersede the existing literature on the subject lately published It however proposes to concern itself with the study and development of high vacuum equipment and large scale vacuum installations developed by the personnel of the University of California Radiation Laboratory in contract with Manhattan Project As such the work should be of immense use in helping to devise some of the best methods of vacuum techniques and to design efficient large scale vacuum installations and equipment

The work is divided into five chapters The first chapter deals with the basic theory of vacuum practice the second with the elements of vacuum systems the third with vacuum gauges the fourth with vacuum materials in equipment and the fifth with leak detection instruments and techniques The work also includes a number of appendices at the end of the volume giving very important data concerning some of the properties of gases and vapours mechanical pump oils diffusion pump oils cold traps effectiveness of drying agents vacuum greases and cements solder brazing alloys and properties of solids and liquids frequently used in vacuum practice Liberal reference has been made to the available literature throughout the book

The book will be found very useful by research workers and may be recommended as a valuable addition to libraries

SWAMI JNANANANDA

The Presentation of Technical Information by Reginald O Kapp (Constable & Co Ltd London Orient Longmans Ltd Bombay Calcutta Madras) 1948 pp 147 Price 6s

THE NEED FOR AN IMPROVEMENT IN THE standard of presentation of technical information is all the more evident in India where no systematic training in this field is given to post graduate students in any of our universities The reviewer who is familiar with material received for publication in a technical journal has often felt that his job would have been far easier and less exacting had the contributors a basic grounding as to how a technical paper or report has to be written Unfortunately none of our universities provide for such a course for post graduate students in science or applied science subjects and the result is that often the contributions received are not what they ought to be

This book is the outcome of a series of lectures delivered by the author at the University College London where a course on presentation of technical informations was started in the Faculty of Engineering The course it is pointed out was to be at the post graduate stage to cover a whole session and to include both lectures and exercises This book should be of special interest to our university authorities and induce them to consider the question of introducing similar courses in the universities Such a step would immensely benefit our young scientists and technicians

The subject matter is classified in 15 short chapters covering practically all aspects Written in simple style and illustrated with a number of appropriate citations from the works of well known authors and scientists the book makes a very good reading

It is difficult to pick out any one chapter as more important than the rest All are, but there are some which provide new ideas The first chapter, which the author terms as "Functional English", deserves a little more attention as it provides the basis for the whole subject, viz the presentation of technical information not only in English language but in a broader sense in any other language What applies to English applies equally well to other languages too Now that the question of presenting technical information in vernaculars is becoming imperative, all those interested in this field would benefit a great deal by a study of the basic principles discussed in this chapter

The rules to be followed in writing technical books, preparation of matter for technical reports and papers and how to deliver talks on technical subjects are the other topics dealt with in the book The hints provided are very useful A series of ' don ts are given in chapters II and VIII, the latter also containing some important ' do's "

In the opinion of the reviewer the book is an useful and important contribution to scientific literature and should find a place in all libraries, even sectional libraries in all research laboratories and technical institutions As a matter of fact, this volume should find a place in the shelf of all research workers

On the last point the reviewer would like to make a suggestion Such a useful publication is rather too highly priced to be within the reach of every research worker The only way to make it accessible to one and all is to bring out a cheaper edition on the lines of Pelican books That would be doing a real service in the cause of science

A K

Bengal in Maps, by Dr S P Chatterjee
(Orient Longmans Ltd), 1949, pp 105
Price Rs 18

THIS IS NOT THE CONVENTIONAL COLLECTION of locational maps, it is a praiseworthy attempt to give in the form of maps a fairly complete picture of the socio-economic pattern of present-day Bengal The author in his preface has traced the circumstances which led to the compilation of these maps

The atlas falls into three broad sections The first part deals with the geographical location of Bengal in relation to the rest of India and Pakistan, the physical features and the climatic conditions throughout the year In this section there are two maps — provocative of interest One is entitled Greater Bengal, and shows the whole region where Bengali is spoken As the author points out, "Bengal may be politically divided today, but the community of language will continue to be the most powerful unifying factor of Greater Bengal" This map and the one on transport reveal clearly the gross injustice of the division of Bengal It may not be possible to agree with the author's view that if these maps had been in print before the final award of Sir Cyril Radcliffe there might have been a more reasonable division of Bengal, for after all that award was largely the result of political considerations The other map, of interest in an entirely different field is the one dealing with the rivers of the eighteenth century It shows clearly how the lapse of two centuries has changed the course of several of these rivers and consequently the layout of the land

The second section deals with the people and their occupations The population changes from 1901 to 1941 are shown in a series of four maps The other maps deal with the distribution of the two main communities the Hindus and the Muslims and the minorities both in East and West Bengal We may however, point out one minor defect in these excellent maps The ' dot system of representation makes these maps look almost alike perhaps if there had been much bigger maps representation by "dots" might have been useful

The last section dealing with the distribution of the economic resources of Bengal is perhaps the most interesting part In a series of maps the author shows the production and yield of various agricultural crops The brief statements about the various crops accompanying the maps are admirably concise and to the point It might have been better if the author had indicated the sources of his information for the details of yield and production This section would have been more complete if the author had added a series of map dealing fully with mineral and animal resources of Bengal The Raniganj coal-mining area is, however, dealt with in one map The pattern of industry in Bengal is also represented in a few maps

On the whole, the author and his associates deserve every praise for having brought out this excellent atlas They have shown that geography is not merely a listing of physical features and climatic conditions of a land, but that it deals with the close and variegated relation between man and the country he lives in We hope that the brilliant example set by Dr Chatterjee may be followed by others and, ere long, we will have similar atlases for other parts of the country

Elements of Internal Combustion Turbine Theory, by H T Adams (Macmillan & Co Ltd, London), 1949, pp 178 + xii Price 16*s*

THE AUTHOR OF THIS BOOK WAS, FOR SOMEtime, Director of Studies to Power Jets Ltd under the Ministry of Aircraft Production He is now Senior Lecturer in Mechanical Engineering at Canterbury University College, and is known as the author of *The Aircraft Gas-Turbine*, issued by His Majesty's Stationery Office

The present volume is most useful and timely Inside the jacket we are told that "this book presents the theory and some of the methods used in the design of the internal combustion turbine during recent years It is intended for advanced students and for engineers A reasonable mathematical background and some knowledge of aerodynamics is assumed, but some fundamentals are given in the first chapter, and worked examples are included where these will help towards a clearer understanding of the principles in the text"

This is a true and concise description Terseness and precision indeed are distinguishing features of the author's style He understands compression in language almost as well as in mechanical compressors, with the result that, although the book is not lengthy, it is a veritable *multum in parvo* The book is divided into 9 chapters as follows: (1) Introduction, (2) Thermodynamic Considerations, (3) The Centrifugal Compressor, (4) The Axial Flow Compressor, (5) The Turbine, (6) Stress Calculations, (7) Vibration, Critical Speeds and Endloads, (8) Overall Performance Correction and Estimation, (9) Heat Exchange and Intercooling

Broadly speaking, the internal combustion turbine is a comparatively late arrival in the engineering world We do not possess the store of practical experience available, for instance, to the designer of steam turbines. Consequently, the numerous technical problems which arise in the design of internal combustion turbines have largely to be solved from first principles, and particularly must the science of fluid dynamics be our guide, philosopher and friend The author is well aware of this, and in the elucidation of the scientific principles involved, he chooses actual and pertinent data for working out examples to elucidate the theory Particularly commendable are his treatment of centrifugal and axial flow compressors, and of the turbine itself and the stresses set up. The only disappointment is that the author has seen fit to exclude anything beyond a casual note on combustion on the grounds that "the subject of combustion is a study in itself" True, but this can be said of all subjects

However, it is impossible to expect everything from a first edition There is no doubt that young engineers and others concerned in the design and performance of internal combustion turbines will be helped considerably by this book which is excellently, yet modestly, printed and produced

J W W

PUBLICATIONS RECEIVED

Progressive Mathematics, by P. CLYNE, Chapman & Hall Ltd, London, 15*s*

Modern Workshop Technology, by H. WRIGHT, Cleaver-Hume Press Ltd, London, 32*s*

Data and Circuits of Receiver and Amplifier Valves (Series of Books on Electronic Valves, Book II), N V Philips Gloeilampenfabrieken (Philips Industries), Eindhoven, Netherlands

Data and Circuits of Receiver and Amplifier Valves (Series of Books on Electronic Valves, Book III), N V Philips Gloeilampenfabrieken (Philips Industries), Eindhoven, Netherlands.

Organic Chemistry (4th English Edition), by PAUL KARRER, Cleaver-Hume Press Ltd., London, 57*s* 6*d*.

NOTES & NEWS

Viridin

A NEW ANTIBIOTIC, VIRIDIN, IS produced by the common soil fungus, *Trichoderma viride* (*Nature*, 1950, 165, 528) Viridin is extracted from the culture filtrate with chloroform After evaporation of the extract under reduced pressure and treatment of the oily residue with ice cold methanol, a slightly coloured crystalline material is isolated Ketonic and non-ketonic forms are separated by reacting with Girard s reagent The ketonic part is further purified by chromatography using a strongly acidic alumina column to separate α and β viridins The α isomer is isolated from the benzene ether eluate After recrystallization from methanol, acetone and finally from dilute acetic acid, α viridin is obtained as fine colourless needles decomp 208°-17°C Analyses and molecular weight determinations reveal that the hitherto accepted molecular formula of the compound should be replaced by $C_{19}H_{16}O_6$

β-viridin isolated from the chloroform eluates and recrystallized from methanol forms fine needles

Viridin is not anti bacterial but is highly anti fungal Germination of the spores of *Botrytis allii* is prevented by a concentration as low as 0 019 p p m of α-viridin or 0 156 p p m β viridin Among synthetic fungicides, only the organo-mercurials are of the same order of activity

Quantitative Study of Viruses

ESTIMATION OF THE POTENCY OF virus preparations is an important factor in the progress of biological investigations A detailed study of the validity of various means of assessing the relative potencies of the virus of foot-and mouth disease has been made in a Report No 8 of the Agricultural Research Council, London (*H M S O*, price *2s 6d*)

The usual method of virus potency by inoculating guinea pigs is inadequate because bovine strains require serial adaptation before they are fully effective upon the smaller host Inoculation of each dilution to a separate bovine host is prohibitively costly To combine effectiveness with reasonable cost 4 dilutions are introduced each with 5 inoculation sites upon the tongue of one Devon Stear 1½ to 2 years old The results are more significant if two animals are used that is 10 inoculations of each dilution The observations are of fundamental importance in the study of plant viruses also

Estimation of Alcohols

THE METHODS USUALLY EMPLOYED for estimation of alcohols are based upon the reaction of the alcohol with acetic anhydride or acetyl chloride followed by hydrolysis of the excess reagent requiring 2 to 24 hr for each determination A procedure requiring only 20 min for the determination of methanol, using acetyl chloride as the reagent is described The reagent which does not enter into ester formation is hydrolysed and titrated with standard alkali (*Proc Indian Acad Sci* 1948 58, 142)

A 20 c c bottle is used as the reaction vessel A measured amount of the reagent is introduced into it by means of a syringe through a rubber stopple in the neck of the bottle The blank was determined as follows About 0 3 c c of acetyl chloride was placed in the bottle and allowed to stand for 5 min The bottle was half-filled with water and the contents emptied after shaking Both the stopple and the bottle were then rinsed with acetone and dried in a current of air 0 3 c c of acetyl chloride was then introduced into the bottle through the stopple by means of a syringe, and allowed to stand for 5 min 10 c c of water was then injected and after shaking, 11 c c of air was withdrawn from the bottle The contents were transferred to an Erlenmeyer flask, bottle was filled with water, one-half emptied into the Erlenmeyer, the bottle shaken and remaining water poured into the flask The contents were titrated with standard alkali using phenolpthalein An actual determination is similarly made, the only difference in the procedure being that a weighed sample of alcohol sealed in a small thin-walled glass ampoule was placed in the bottle before the stopple was inserted and the glass bottle was broken after the addition of the acetyl chloride

If a series of determinations is interupted for more than a few minutes, it is necessary to pretreat the rubber stopple again with acetyl chloride before continuing Each day a new blank should be run

Blast-furnace Slag Cements

THE SHORTAGE OF CEMENT DURING the war led to investigations on the possibility of increasing its production by making greater use of granulated blast furnace slag A survey of suitable slags for this purpose was undertaken by the Building Research Station, England (*Technical Paper No* 3 National Building Studies, *H M S O* price *9d*)

The normal method of slag granulation is to prepare batches of about half a ton by slowly pouring the molten slag into a large excess of cold water Whenever possible the granulation is carried out as the slag leaves the furnace The slags tested have considerable hydraulic value and most of the experimental cements satisfied B S 146 Although haematite slags gave the best results, there is considerable overlapping with the basic and foundry-iron slags The early strength is considerably affected by the ratio of gypsum to clinker and by impurities such as chlorides introduced in the slag There is little change in the hydraulicity of a slag when granulated by different methods The method of granulation did however, make considerable differences in the weight per cu ft the water retained after draining and grindability

Samples of granulated slag have been incorporated into experimental blast furnace cements The standard proportion employed was 65 35 of dry slag to clinker gypsum being added so that the ratio of SO_3 to clinker was the same as that in Portland cement The hydraulic value of the slags is best judged by a comparison of the 90 days strengths of the concretes made from the corresponding cements using the same clinker for activation

These slags with a high ratio basic oxides to acidic oxides are preferred for cement manufacture and many operators consider that there is an optimum value for the Al_2O_3 content.

Granulated slags are only feebly hydraulic when mixed with water alone, in order to develop their full strength they need to be mixed with another material usually called an activator The activator in blast-furnace cement is the lime set free during the hydration of the Portland cement clinker It is possible, therefore, that the hydraulicity of a slag may depend on the type of clinker used Rapid hardening Portland cements develop the hydraulicity of the slag more than normal types

Salt Manufacture in Philippines

PRODUCTION OF SALT IN THE Philippines employing modified solar process technique has been described (*Philippine J of Sci*, 1949, **78**, 85)

In the local method raw sea water is evaporated in a series of fish ponds (which are used to produce salt during the dry months) to about 15°Bé which is then dipped with buckets into crystallizing ponds where it is evaporated almost to dryness and the salt recovered The crystallizing ponds are about 5 m × 7 m equipped with board sides and tile bottoms and usually represent from $\frac{1}{10}$ to $\frac{1}{8}$ of the entire area of the salt works Every day in the season, the ponds are filled to a depth of about 1 cm and late in the afternoon after each day of evaporation the salt is raked into a pile on the side of the crystallization bed and the pond re-filled This process is continued throughout the season, without any change, until the brine level builds up with a heavy brine containing a large percentage of the magnesium salts. When this happens, the salt producer will probably let the pond go for a day or more without adding fresh brine, and will then, after harvesting the salt, splash out of the pond the remainder of the brine Owing to the high magnesium content, this method of handling produces a very inferior product. It is the common practice of the salt producers in the Manila area to fill the crystallization beds with brine of 12° to 17°Bé which is the point at which calcium sulphate begins to precipitate, and thus practically all the calcium sulphate is found in the final products as an impurity Further, it may be noted that the practice of using an unsaturated brine in the crystallizers results in a lower yield since a portion of each day is spent in evaporating the brine to a point where salt will begin to form at 25°Bé

In the Californian process which is a great improvement over the above practice, the operations are conducted in various ponds (1) the storage or intake pond, (2) concentrating ponds, and (3) crystallizing ponds The salt water is pumped from the intake pond into the concentrating ponds to a depth of 25 to 50 cm before the next supply of sea water is taken in When the strength of the brine reaches 25°Bé, it is run into crystallizing ponds to a depth of 15 cm or more This depth of brine causes the deposition of large crystals which grow into massive solid crystals of pure salt The brine evaporates until it has reached a density of 29°Bé, at which time the bittern is either discarded or evaporated in other ponds to a density of 32°Bé This salt formed from the heavier bittern is less pure The process is repeated until the end of the season or until a thick enough bed of salt is obtained to make harvesting economical All the ponds have mud bottoms, and often a split is made in the harvesting, i e the lower 5 cm layer is removed separately and used as a cheaper salt The harvested salt is washed with brine and with fresh water whereby salt of over 99 5 per cent sodium chloride content is obtained

Experiments designed to increase operational efficiency showed that it was possible to reduce the area of crystallization beds by about one-third the present space without affecting the yield In these experiments one crystallizing pond was filled with the brine at 14°Bé After it had evaporated to 25°Bé, it was pumped into a second pond 56 kg of salt was realized from the experimental plot in 2 weeks as against only 30 kg from the control plot Studies on conditions affecting the rate of evaporation showed that the rate is not influenced by depth of brine, when the bottom does not reflect the sun's rays When, however, the bottom reflects the sun's rays, the evaporation proceeds more rapidly from the deeper water No significant differences are observed in the rates of evaporation with tile and mud bottoms

Measurement of temperature and density variations at various points on a salt farm over a period of most active evaporation indicated that the temperature of the brine in the ditch was higher at the bottom than at the surface Also the brine at the bottom of the ditch was of greater density than that at the surface

New Industrial Carbons

DEVELOPMENT OF A NEW TYPE of industrial carbon and graphite for chemical engineering plant components, where inertness and high mechanical properties are essential, is reported at the *Powell Duffryn Research Laboratories* The new materials (Delanium) are characterized by their homegeneity as opposed to other types of carbon products In the production of these materials an extraneous binder is not employed thereby eliminating porosity

Finely coking coal, ground with small quantities of materials inhibiting swelling, is pressed or extruded to the desired form and fired in a controlled atmosphere in a temperature cycle giving maximum shrinkage (as much as 45 per cent) without distortion The final product has low porosity and high mechanical strength By a suitable choice of coal, swelling inhibitors, firing atmospheres and temperatures, a variety of Delanium carbons having a wide range of mechanical, thermal, electrical and chemical properties can be produced With appropriate heat treatment, this carbon graphitizes and products with a wide range of physical, chemical and electrical properties are obtained

Some of the basic characteristics of the new carbon and graphite are

PROPERTY	DELANIUM CARBON	DELANIUM GRAPHITE
Apparent density	1 55	1 70
Electrical resistance ohm/in	007	0007
Thermal conductivity, B Th U /sq ft /hr /°F./ft	3	40
Transverse strength lb /sq in.	12,000	8,000
Compressive strength lb./sq in.	38,000	20,000
Scleroscope hardness	85	65
Coefficient of thermal expansion	3 8 × 10^{-6}/°C.	3 8 × 10^{-6}/°C.

A honeycomb block made of this graphite has been employed as a heat exchanger This exchanger is strong and compact and is capable of conducting 500 B Th U /sq ft./hr /°F A conducting area of 50 sq ft. is afforded by a perforated 15 in cube The new carbon in a special form has been successfully employed to form a new type of packing for scrubbing and similar towers, chemically resistant and with good wetting properties Formation of tiles from the carbon to line chemical vats is another suggested use for the product (*Chem Age*, 1950, **62**, 405)

Improved Alkali Processes

AT A RECENT MEETING OF THE American Institute of Chemical Engineers, some of the modern trends in alkali production were discussed (*Chem Age*, 1950, **62**, 395) The early cells were designed for 1,000 to 1,500 amp but the modern practice is to employ cells operating at higher amperage It is more economical to use Hooker type cells at 8,000 to 10,000 amp in plants with a capacity of 5 tons than to use smaller cells In plants of 50 tons capacity and over, a 20,000 amp cell is more economical than a 10,000 amp cell

Larger electrolytic cells are being designed to increase their efficiency in the manufacture of chlorine and caustic soda, the largest unit, a 50,000 amp mercury cell, is being installed in France Bigger *type S* cells have been found even in small plants to be more economical than the smaller ones

Surplus hydrochloric acid gas is used as the raw material to yield high purity chlorine gas in a newly developed process Cupric chloride is electrolysed to produce chlorine gas and cuprous chloride The latter is then oxidized by hydrochloric acid and oxygen to produce more cupric chloride This method is claimed to be superior to current methods in practice.

A recent improved process for refining caustic soda is to evaporate a 50 per cent solution nearly dry at 700°F using Dowtherm vapour to supply heat Contamination of the product and corrosion of equipment are avoided by purifying the lye before evaporation and using nickel equipment The practical possibilities of this process have been demonstrated in a small plant producing continuously 60 tons per day

Chlorination of benzene can be effected in a single step by passing chlorine, air and benzene through tubes containing newly developed catalysts which permit operations at below 500°F

Colourless Fluorescent Dyes

COLOURLESS FLUORESCENT DYES are finding increasing application in the textile, soap, paper and laundry industries since they enhance the whiteness of materials to a considerable degree (*C T J*, 1950, **126**, 827) These substances, applied after the normal bleaching process, give a remarkable luminosity which could not previously be achieved and which does not have any detrimental effect on the textile fibre The general requirements of a satisfactory white-dyeing agent are it should be absorbed substantively by the fibre from aqueous solution so as to give a satisfactory, i e greenish to blue tint, it should have good wet-fastness properties, the agent should be stable towards weak acids and alkalies and should be compatible with other finishing agents it should be suitable for direct use in the bleaching vats and should be fast to light

Nearly all the known technical products belong to the aromatic or heterocyclic series, many of them contain condensed ring systems Most of the whitening agents used on cellulosic fibres are derivatives of diaminostilbenedisulphonic acid These are also used as additions to detergents and rinsing products Benziminazole and glyoxaline derivatives are also advocated Diphenylglyoxalinonesulphonic acid is known especially for application to wool

In the textile industry, whitening agents have been employed with success in the bleaching of white goods, especially of cotton, but one cannot completely dispense with chemical bleaching If the fabric is not already bleached, i e if it has not a sufficient degree of whiteness, then a colourless whitening agent with blue fluorescence cannot compensate for the yellow or brown colour of the fabric White-dyeing agents have proved economical in the treatment of multi-coloured piece-goods because their application permits grey or scoured instead of bleached yarns to be used In the treatment of cotton knitted goods made of grey yarns, bleaching time can be substantially shortened by performing only one bleach with chlorine, followed by white dyeing, instead of a combined chlorine-hydrogen peroxide bleach Whitening agents have afforded new possibilities in the manufacture of viscose rayon and viscose staple fibre (spun viscose) The product can be added directly to the xanthate before the spinning process when the viscose rayon is brightened in the mass In the dyeing of pastel colours the addition of the fluorescent dye to the exhausted dye-bath gives a better effect than when the normal dye is applied to a previously white-dyed material White-dyeing agents brighten up white discharge patterns and ameliorate the contrast of coloured prints in calico printing by a preliminary treatment or in a separate bath following printing and rinsing

In the paper industry, apart from treating cellulose wadding, cigarette papers and crepe papers, whitening agents can be applied to wool-mottling fibres meant for bank-note paper and paper for securities White-dyeing agents can be used in the soap industry as additives to soap powders, being adsorbed by and bleaching the textile during washing, whitening of soap or soap powder itself to improve its appearance, as a combination of both and as additives to rinsing agents

There have been few products suitable for application to wool For this purpose, products should be much as could be used in neutral or slightly alkaline baths to obtain good whitening effect on raw wool by treating it either in a scouring operation or in a peroxide bleaching bath No satisfactory white-dyeing agent exists for acetate rayon but it is possible to white-dye nylon, which is comparatively difficult to bleach to a pure white by using the typical white-dyeing agents for wool

Carbonate-free Sodium Hydroxide

CARBONATE-HYDROXIDE ION EXCHANGE studies on the strong base resin *Amberlite IRA*-400 (manufactured by Rohm & Haas Co) have indicated the possibility of separating carbonate from hydroxide by chromatographic means, thus offering a simple method of preparing carbonate-free sodium hydroxide.

A little in excess of the required amount of alkali is made up from washed sodium hydroxide sticks and a column of the resin, which may be initially in the form of its chloride, is prepared. The capacity of the air-dry resin is 1·4 milli-equivalents per gram, and a 50 c.c. tube two-thirds full of resin would be suitable for preparing 1 litre of 0·1 *N* sodium hydroxide. The alkali is passed through the resin until the effluent is chloride-free and the tube is then transferred to the neck of the stock bottle. When the rest of the alkali has passed through, the resin column is replaced by a soda-lime guard tube and the carbonate-free sodium hydroxide is then ready for standardization.

The column can be easily regenerated by the passage of hydrochloric acid (*Nature*, 1950, **165**, 237).

Adulteration of Mustard Oil

PROBLEMS RELATING TO THE DEtoxication of mustard oil contaminated with argemone oil (*Argemone mexicana*) to render it safe for human consumption and the separation of argemone seeds from a mixture of argemone and mustard seeds were discussed at a joint meeting of the Food Standards Committee of the Technical Panel (Ministry of Food) and the Central Committee for Food Standards (Ministry of Health), held in March 1950 in New Delhi.

In the investigations conducted by Dr A. C. Roy and Dr Surajdeo Prasad of the Industrial Research Laboratory, Patna, the alkaloid sanguinarine is precipitated from a mixture of mustard oil and argemone seed oil as phosphate by addition of phosphoric acid. Subsequently, acid-activated Fuller's earth and excess of chalk are added to neutralize the free phosphoric acid. The filter-pressed oil retains most of the original mustard oil colour and flavour and does not give a test for the presence of the argemone oil alkaloid. This treatment costs Rs. 2 per md of oil processed.

A method by Dr Surajdeo Prasad for a complete separation of argemone seeds from mustard seeds consists in blowing the seed mixture through a glass tube with the help of an air current. Argemone seeds being lighter are pushed out and the rape and mustard seeds collect at the bottom of the tube.

The Committee agreed that the ferric chloride test evolved by Sarkar and modified by Sen, Sundaram and Roy be accepted as the standard method of detection of argemone oil contamination in mustard oil. It was pointed out that if the ferric chloride concentration was doubled, the test was more pronounced and even 0·1 per cent adulteration could be detected.

Control of Seed-borne Diseases

HIGH FREQUENCY DIELECTRIC heating has been employed for the control of internal seed-borne fungal diseases (*Nature*, 1950, **165**, 532). Preliminary work has been carried out with the seed-borne phase of leaf stripe of oats (*Helminthosporium avenae*), as the amount of this disease can be estimated fairly rapidly by growing the oats to the seedling stage or by plating out the seeds in petri-dishes. Oats, having a 13 per cent infection with leaf stripe and contained in a cardboard box having no metal parts, were placed between the electrodes of a standard RH 23 Redifon radio frequency generator. They were heated to the required temperature and maintained at that value for 20 min. The oats were then spread out to cool and 50 seeds were sown in each of the 8 pans of sterilized sand. Subsequent growth in a greenhouse allowed the estimation of the number of plants showing the seedling phase of leaf stripe.

Heating at 60°C for 20 min reduced the amount of leaf stripe to about 50 per cent without greatly impairing their germination. Higher temperatures reduced the amount of disease but depressed germination also, lower temperatures had little effect. Heating at 60°C for longer periods affected the germination more than the leaf stripe. Moisture content of grain also affects the rate of heating.

Preservation of Fish

THE OLDER METHODS OF PREserving fish such as heavy salting, drying and smoking, and the current method of chilling the fish with crushed ice have various disadvantages. In contrast with these, freezing and cold storage properly applied can preserve fish of all kinds, either fresh or lightly smoked, in good condition for periods up to 9 months. The basic principles underlying modern preservation techniques are outlined in leaflet No. 11 of the *D.S.I.R.*, London (*H.M.S.O.*, price 6*d*).

Factors affecting the quality of frozen fish are temperature and conditions of storage, rate of freezing, freshness of the raw material and conditions of thawing. *Sharp* rather than *rapid* freezing of smoke-cured fish with an overall freezing time of up to 24 hr usually results in a good product.

For efficient freezing and cold storage it is recommended that fish should be frozen within 24 hr of catching. The period elapsing between removal of fish from storage in ice to the commencement of freezing should be as short as possible. Glazing of fish at 35°-40°F has been found more suitable for protecting whole fish or blocks of small fish than wrapping.

New Stainless Steel

THE NEW STAINLESS STEEL CONtaining 17 per cent chromium, 4 per cent nickel and 4 per cent copper has excellent corrosion resistance, high strength and hardness, ease of fabrication and low temperature hardenability. It is recommended for use in the chemical, petroleum, textile and food processing industries, for springs, pressure tanks, conveyer parts, etc., and especially in the aircraft and automobile industries.

This steel is available in soft temper strip, sheet and plate and can be easily fabricated by standard procedures and then brought to full strength and hardness by heating at 1,400°F for 30 min., air cooling and reheating to about 900°F. The hardening process eliminates cracking, distortion and decarburization encountered in conventional heat treatment (*Sci. Newsletter*, 1950, **57**, 105).

New Dyeing Process

A CONTINUOUS NOVEL DYEING process employing molten metal as the medium to fix the dye has been developed (*C.T.J.*, 1950, **126**, 874).

The unit comprises a continuous vat dyeing machine with an iron vessel filled with a fusible alloy (m p 70°C) and a conventional soaping range running as a single unit. Cloth is passed through the dye liquor directly into the molten metal maintained at 95°-105°C where all excess of dye liquor is squeezed out

The molten metal serves as a source of rapidly transferable heat, excludes all air and exerts a uniform pressure on the cloth surface The process is reported to give increased penetration and full fixation and fastness in a few seconds Any vat colour or a combination of vat colours may be employed at any depth of shade at speeds from 30 to 120 yd per min

Selective Herbicide

MALEIC HYDRAZIDE HAS BEEN found to be highly selective in its action as a weed killer It has rapid lethal effect on weed grasses — water grass, Johnson grass, barley, etc, but has no noticeable effect on cotton plants The age of the sprayed plants, however, makes a difference, even cotton is affected if sprayed too young (*Science Newsletter*, 1950, 57, 107)

Aeroplane Load Adjuster

THE WEIGHT AND BALANCE CONtrol of transport aircraft is at present achieved by the use of mechanical computers or load and trim sheets. These have serious limitations in that they lack flexibility, are not sufficiently accurate and are time-consuming A portable electrical instrument for rapid determination of the centre of gravity of Viking Mk IB aircraft for any load distribution has been developed in the *Research & Development Laboratory* of the Civil Aviation Department, Government of India The basic principle of the instrument is also applicable to other types of aircraft.

The general working arrangement is indicated in Fig 1 Switches located in a similar configuration as the passenger seats correspond to the number of passengers in the aircraft. The on and off positions of each switch will correspond to whether the seat is occupied or not. The weight of fuel in the tanks and freight and baggage in the holds are adjustable by variable control tanks suitably graduated in convenient steps The actual position of C G is given on a C G dial indicator whose scale is graduated directly in inches aft or forward of the specified datum point

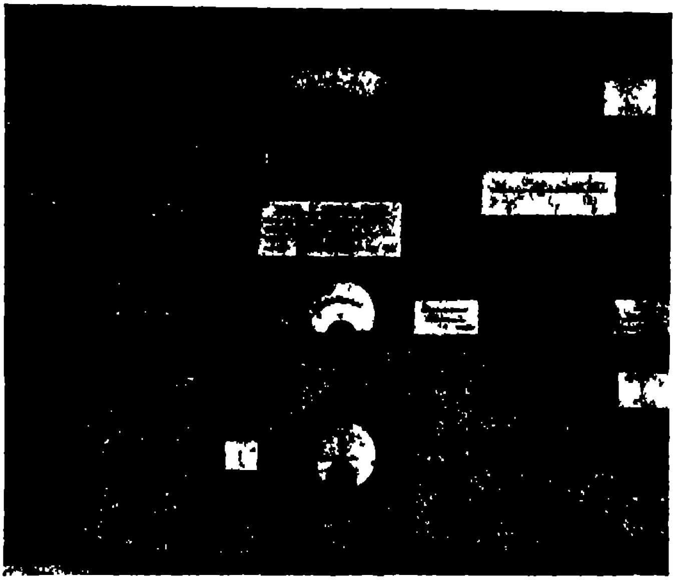


FIG 1

To operate the instrument, the switches and control knobs are set to correspond to the actual load distribution and the galvanometer is adjusted to read zero The main current is adjusted to a specified value which is an instrument constant The actual position of C G is then read directly on the dial indicator The instrument is highly accurate, adaptable and easy to operate

Aluminium & Its Alloys

THE REVISED EDITION (DECEMber 1949) of *The Properties of Aluminium & Its Alloys* (Information Bulletin No 2, Aluminium Development Association, London) has been considerably enlarged and brought up to date to include specified alloy composition, types of treatment and minimum mechanical properties of aluminium and its alloys, together with other data on physical and chemical properties The data are in accordance with the new series of BSI Specifications (B S 1470-7 and 1490) Characteristics affecting design such as elasticity, rigidity, shear, bearing and fatigue strengths and strengths in compression and at elevated temperatures are enumerated Durability and working methods in relation to properties of materials are discussed briefly with reference to other publications on the subject There are two appendices Appendix I gives average weights of aluminium alloys in standard forms Appendix II relates to the new nomenclature and contains specifications which are the nearest equivalents to those in the new series of standards This data have also been given in detail in a separate chart issued during February 1950 The bulletin is supplemented by an useful bibliography on fatigue and high temperature properties

Standard Methods of Analysis for Textiles

THREE INDIAN STANDARDS FOR the analysis of textile materials have been issued prescribing standard methods for estimation of (1) moisture, total size, starch, ash and wax content in grey and bleached cotton materials, sampling procedures, (2) determination of copper number of cotton textile materials, and (3) methods for analysis of and tolerances for water for textile purpose

Copies of these standards are available from the Secretary (Administration), Indian Standards

Institution, 19 University Road, Delhi 2

The Institution of Land Surveyors

AT ITS ELEVENTH MEETING HELD in New Delhi on May 8 1950 under the presidentship of the Hon'ble Pandit Jawaharlal Nehru, the Advisory Committee for Co-ordinating Scientific Work Sub-Committee finalized a plan for the establishment of the Institution of Land Surveyors in India The headquarters will be located at Delhi with branches at other centres The membership will consist of four classes students associate members members and honorary members

The aims and objects of the Institution are to function as a learned scientific body and promote the science and practice of surveying namely land surveying building and quantity surveying and other branches such as valuation land agency mining and agriculture Further it would endeavour to foster all objects having a bearing on the professional activities of surveyors including liaison with other allied recognized professional bodies, provide a channel with other allied recognized professional bodies and diffuse among corporate members information on all matters affecting surveying

The Institution also will *inter alia* test by examination the competence of persons for admission to corporate membership of the Institution At present the only place of training in India is the Geodetic Training Centre of the Survey of India at Dehra Dun and although departmental examinations are held for trainees they are not given any diplomas or certificates as a result of the tests, but have to go abroad if they wish to obtain any degree or diploma This lacuna would be remedied by the holding of examinations by the Institution of Surveyors

Further information on the subject may be obtained from the Surveyor General of India, New Delhi

Marine Biological Station at Andamans

AT ITS MEETING HELD ON THE 14th December 1948, the Advisory Committee for Co-ordinating Scientific Work considered a scheme for the establishment of a Marine Biological Station prepared by Dr Baini Prashad, Fisheries Development Adviser to the Government of India, and recommended that it would be of advantage from the point of view of developing the fishery industry, if a " Fishery Development Station combined with a Research Station could be set up in the Andamans This station could later on be developed further and as the UNESCO has under consideration the establishment of one or more Institutes of Oceanography and Fisheries in Asia the existence of this station would be an invitation to the United Nations to set up such an Institution in the Andamans

The Committee at its recent meeting held on the 20th May 1950 considered that the scheme for the establishment of a Marine Biological Station in the Andamans should be proceeded with by the Department of Scientific Research and as a first step the Department should appoint a scientist to plan the setting up of a station on an adequate scale The plan should be such that the scheme could be implemented by stages so that funds are not required all at once

River Research Institute, West Bengal

THE FOUNDATION STONE OF THE central laboratory of the River Research Institute at Haringhata was laid on the 21st May 1950 by Dr B C Roy, Chief Minister of West Bengal

The Institute will investigate into the causes of deterioration in the drainage system in West Bengal and find ways and means to revive Bengal s rivers which are fast silting up and causing formation of swamps and difficulties in navigation

Abstracting Services

THE FIRST EDITION OF THE LIST of Current Specialized Abstracting and Indexing Services" has been prepared by the International Federation for Documentation The list is a first attempt to prepare a guide of abstracting and indexing services, mainly in the field of pure and applied science The list contains the titles and places of publication of abstracting and indexing periodicals also the numbers of abstracts they produce, their frequency of publication, subscription rates and the languages in which they appear Copies (Price, 26 13 Dutch florins) of the original card-files of abstracting and indexing services at the FID Secretariat may be obtained from the FIX, 6 Willem Witsen-plein, The Hague Netherlands

Japanese Technicians for India

SCAP HAS NOW AGREED, SUBJECT to certain conditions, to permit the employment of Japanese technicians in India Indian industrialists desirous of obtaining their services should forward their applications through the Ministry of Industry & Supply which, in consultation with the Ministry of Finance scrutinizes these applications before forwarding them to the Indian Liaison Mission to Tokyo which is the actual recruiting authority

Announcements

International Congress on Archives — The first International Congress on Archives is due to meet in Paris from August 23 to 26, 1950 Dr Purnendu Basu, Director of Archives, Government of India has been elected as a member of the Congress vice Dr S N Sen, former Director of Archives

U S Travel Grants for Indian Students — The United States Educational Foundation established in India under the Fulbright Agreement to finance educational exchange programmes, will also utilize part of its funds to provide free transportation to selected Indian scholars who wish to attend U S educational institutions in the United States Hawaii, Alaska (including the Aleutian Islands), Puerto Rico and the Virgin Islands Applications on prescribed forms may be made direct to the Executive Secretary, U S Educational Foundation, American Embassy, Queensway, New Delhi The forms are obtainable from the same office

Government of India Overseas Scholarships — The Government have decided to award 6 scholarships under the modified scheme this year by an open selection to be conducted by the Union Public Service Commission Applications will be received by the Commission in accordance with the instructions to be issued shortly

Organization & Progress of Scientific Research in India

THE annual report of the Department of Scientific Research Government of India for the year 1949 50 records considerable progress in all its activities and particularly in the organization of scientific work The report is in two parts the first deals with the organizational activities the work of the Atomic Energy Commission and the Advisory Committee for Co ordinating Scientific Work grants in aid to scientific societies and research institutions and scientific liaison The second part gives a brief résumé of the activities of the Council of Scientific & Industrial Research under the Directorship of Dr Shanti Swarup Bhatnagar

The Atomic Energy Commission is taking stock of the country s resources for the development of atomic energy process with a view to planning its future development Developments in the field of atomic energy will depend a great deal on fundamental research and to encourage this the commission has sponsored a large number of research schemes on nuclear physics During 1948 49 and 1949 50 the Commission sanctioned grants totalling Rs 2 33 332 and Rs 2 25 150 respectively for this purpose

Considerable progress has been recorded in the field of cosmic rays and in the training of physicists chemists and technicians for specialized work on atomic energy Instruments employed in atomic energy research are being made at the Tata Institute of Fundamental Research Bombay The Commission s laboratory is located in Bombay in close proximity to the Tata Institute

Under the auspices of the Commission a conference of representatives of universities and scientists was held in January 1949 to draw up syllabuses for the teaching of mathematics physics and chemistry in Indian universities The courses have been finalized The expert assistance of Prof S N Bose of Calcutta University has been taken for the promotion and teaching of these subjects in universities A chair of Theoretical Physics is being maintained at the Physical Research Laboratory Ahmedabad The Commission proposes to subsidize the teaching of other universities where necessary to enable the training of students to the standard required for work under the Atomic Energy Commission

A Rare Minerals Section of the Commission has been set up to survey the location of minerals useful for atomic energy work This unit has surveyed the beryl deposits in the country The geologists of the unit are advising mine owners on the methods of mining the ore and exploratory surveys have been undertaken for the location of new deposits An assessment of India s monazite resources is also being made and detailed survey is in progress A factory for processing 1 500 tons of monazite sands is being set up When the factory will be working in full swing India would be self-sufficient with respect to thorium cerium and other rare earth metals which are now being imported for use in the manufacture of gas mantles metallurgical industries etc

The Department of Scientific Research effects co ordination of scientific work through an Advisory Committee of scientists representing the various Ministries of the Government of India The Committee presided over by the Hon ble Prime Minister has met 5 times during the year The more important schemes drawn up under the aegis of this Committee are (1) A scheme for the establishment of a Marine Biological Station in the Andamans the scheme is being implemented (2) A micro film service unit which was previously working for the Indian Research Fund Association has now agreed to carry out work for all the Ministries of the Government of India as well as for private scientific societies research institutes and universities (3) A special committee has been set up to compile instructions for the preparation of scientific communications The same committee will draw up instructions for the training of scientists for information services (4) Ways and means for setting up of national parks and sanctuaries in India for the conservation of wild life are being examined by a sub committee constituted for the purpose (5) The Indian National Committee on Type Cultures is preparing a directory of type cultures maintained at different centres in India Supplies of type cultures are being made to laboratories and industries (6) Various committees functioning both under Government and semi Government auspices have been examined and suggestions made for setting up of committees for subjects which were previously not being studied The most important of these is the committee under the Ministry of Communications to advise that Ministry on technical administrative and economic aspects of air services in India (7) A plan for the formation of an Institution of Land Surveyors has been finalized (8) A science congress of people living around the Indian Ocean is to be held in India in 1951 under the aegis of the Department of Scientific Research and the Indian Science Congress Association (9) A monthly publication describing in popular language the progress of scientific research in India is to be published and (10) the Department issues bi monthly reports giving the latest scientific and technical information

The bi monthly reports from the Indian Scientific Liaison Office in U K describing technical and scientific developments in the laboratories of the U K have proved most useful to research institutions and universities in the country The Indian Scientific Liaison Officer in U K works as the Assessor to the Pest Infestation Board of the Department of Scientific & Industrial Research U K

The Department has since its inception served as a clearing house for scientific information An index of scientific articles translated from various languages into English has been prepared

India is a member of the International Council of Scientific Unions and of a number of Inter national unions The Department collects literature from these Unions and circulates them to Ministries universities research institutions and scientific societies

A project report on Science and Its Social Relations ' is being prepared by Mr J M Sen with a view to introduce that subject for study in the universities of India

The year under review has been a landmark in the progress of activities of the *Council of Scientific & Industrial Research* The following 5 National laboratories started work in their own buildings The National Physical Laboratory New Delhi The National Chemical Laboratory Poona The National Metallurgical Laboratory Jamshedpur The National Fuel Research Institute Dhanbad and The Central Glass & Ceramic Research Institute Calcutta

The first two the National Physical Laboratory and the National Chemical Laboratory were formally declared open in January 1950 The Central Drug Research Institute at Lucknow and the Central Food Technological Institute at Mysore also started work in the palatial buildings acquired for the purpose

There are at present 23 Research Committees each devoted to special branches of science The Committees keep a watch on the progress of scientific research and developmental work in India in their special fields and advise the Council from time to time on the steps to be taken for the furtherance of these activities 89 schemes of research were sponsored by the Council during the year and are being investigated in the various universities and research institutions

The more important projects carried out during the year are production of pure manganese from Indian raw materials dyestuff intermediates for direct cotton colours by electrolytic reduction of aromatic nitro compounds in acid and alkaline media and the analysis of well known dyestuffs and their duplication in India printing ink for newspapers synthetic tanning materials from bhilawan nuts washability of Indian coals and blending of coals for coking studies in the construction of low cost houses anti malarial drugs production of radio valves in India substitution of nickel by manganese in the production of austenitic steels developments of new strains of yeast for producing high concentration distillery washes insulation boards for prefab houses survey and collection of medicinal plants fundamental researches on X ray investigation of coal ionospheric investigations spectroscopy of fuels industrial catalysts infra red radiation from the atmosphere properties of quartz and diamond tools — all sponsored by the Council

Three new committees viz the Salt Research Committee the Mining Research Station Committee and the Malaria Chemotheraphy Committee were constituted during the year

With a view to foster the study of microwaves and radar and their applications in meteorology defence and civil aviation and scientific research in general the Council organized a symposium on microwaves during the year

FORTHCOMING INTERNATIONAL CONGRESSES — 1950

Date	*Conference*	*Sponsored by*	*Venue*
Aug 10	Executive Board International Council of Scientific Unions	ICSU	Berne
Aug 14	Union Internationale d Histoire De Sciences General Assembly and 6th International Congress	IUHS	Amsterdam
Aug 15	16th International Congress of Physiology		Copenhagen
Aug 17	5th International Congress for Microbiology		Rio de Janeiro
Aug 22	International Academy of History of Sciences		Amsterdam
Aug 28	Executive Committee International Geographical Union	IGU	London
Aug 30	International Conference on Mathematics	American Mathematical Society	Cambridge Mass U S A
Sept 4	International Congress of Cell Biology		Yale University
Sept 4	Joint Commission on Ionosphere	ICSU	Brussels
Sept 11	International Meeting of the Association for the Advancement of Science	UNESCO	Paris
Sept 11	Union Radio Scientifique Internationale	URSI	Zurich
Sept 12	Symposium on Motions of the Earth s Crust	I U P M I G G U	Washington
Oct 2	Pan American Institute of Geography and History		Chile Santiago
Oct 4	International Union for Exploration of the Ocean		Edinburgh

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India* Part II Section 1 for May 1950

Organic Chemicals

41176 Improvements in the production of aromatic hydrocarbons *Vaporised hydrocarbon is passed through a reactor fitted with non absorptive ceramic bodies in the temperature region of* 1 000°C — Petrocarbon Ltd

41178 Conversion of hydrocarbons by thermal treatment *Passing the liquid starting material through a number of reactors fitted inside a furnace heated by burners or gases wherein a cooling of blanket of gases is introduced into the furnace* — Petrocarbon Ltd

41927 Improvements in the preparation of pteridines *Mixing a 2 amino 4 hydroxy 6 or 7 halomethyl pyrimido* (*4 5 b*) *pyrazine with para amino benzoic acid of a salt ester or amide thereof in water at a* pH *of* 9 *to* 11 5 — American Cyanamid Co

42888 Improvements in the preparation of phenthiazine derivatives *Condensation effected in presence of alkali metals or their derivatives which form metal derivatives of phenthiazine under conditions of reaction* — Societe Des Usines Chimiques Rhone Poulenc

42037 Manufacture of new phenanthrene carboxylic acid nitriles and derivatives thereof *By treating a 1 keto 2 13 dimethyl perhydro phenanthrene with a halogenating agent and reacting the resulting halide with a metal cyanide* — Ciba Ltd

42145 Improvements in the chlorination of organic compounds *Introducing water or aqueous solution into reaction vessel at the top so that it passes through the compound to be chlorinated* — Koninklijke Industrieele Maatschappij Voorheen Noury & Van Der Lande N V

42164 New pyrimidine derivatives *Reacting a halogenated lower alkylamino pyrimidine derivative with a quarternary salt forming agent* — I C I Ltd

42165 66 New quinoline derivatives 2 4 *and/or* 6 *amino alkyl and/or alkylamino pyrimidine nuclear is condensed with alkylamino quinaldine nuclear 4 alkylamino-6* (*2 6 or 4 alkyl and/or alkylamino pyrimidyl*) *quinaldine is reacted with a quarternary salt forming agent*—I C I Ltd

42430 37 Process for the manufacture of organic amino diols *Phenyl alkyl ketone is condensed with β nitroethanol and thereafter reducing the nitro diol into amino diol compound*

Process for the manufacture of diacylated organic amino diols 1 *phenyl 2 aminopropane* 1 *3-diol is heated with excess of acyl halide or acyl anhydride to obtain 1-phenyl 2 acylamido 3 acyloxypropane 1 ol compound*

Process for the manufacture of completely acylated organic amino diols 1 *phenyl* 2 *amino* (*or acetamido*) *propane* 1 3-*diol is reacted with acyl anhydride or acyl halide under anhydrous condition to obtain the corresponding acylated compound*

Process for the manufacture of aromatic nitro compounds 1 *phenyl* 1 3 *diacyloxy* 2 *acylamino propane is nitrated with sulphuric acid nitric acid mixture to obtain* 1 *para nitro phenyl* 1 3 *diacyloxy* 2 *acylaminopropane*

Process for the manufacture of organic amino diols 1 *p nitrophenyl* 1 3 *diacyloxy* 2 *acylaminopropane is hydrolysed with an acidic or alkaline hydrolytic agent to obtain a free amino diol*

Process for the manufacture of diastereoisomers of organic amino diols *Crystallising the compound from an organic solvent in which one of the structural forms is more soluble than the other and separating the least soluble therefrom*

Process for the manufacture of optically active organic amino diols *Reacting the amino diol with an optically active acid and then separating the acid addition salts of the dextro and levo isomers* — Parke Davis & Co

Fuels & Lubricants

41993 Improvements relating to medium for sink and float coal washing plants *Subjecting coarse blast furnace flue dust to a magnetic concentration the recovered finely divided magnetic iron oxide provides the separating medium* Simon Carves Ltd

Metal & Metal Products

41831 Method of producing nodular cast iron *Melting a carbide metal stabiliser agent to a molten iron then graphitising the melt and pouring a casting from the melt* — Smalley

41832 Method for desulphurizing iron and steel with metal hydrides *Introducing a reagent comprising at least one metal to reduce sulphur content* — Smalley

Paper & Allied Products

42068 Lowering the hemicellulose and ash content of chemical wood or bamboo pulp in the manufacture of high alpha cellulose content pulps for use in the manufacture of paper rayon acetate silk plastics etc *Treating with alkali and finally bleaching with hydrochloride* — Trivedi

Miscellaneous

42370 Improvements in the treatment of cellulosic material to impart flame resistance thereto *Impregnating cellulosic material with an ingredient comprising metallic oxides a thermoplastics substance a water soluble salt of phosphorous and a water soluble nitrogenous substance such as urea* — American Cynamid Co

42826 Improvements in method of separating stalk and foreign matter from dried or fired tea and for cutting or breaking the tea at the same time if desired — Ruddiman

Patented Inventions of the Council of Scientific & Industrial Research

CONVERSION OF CASHEW-NUT SHELL LIQUID TO A DRYING PRODUCT

Patent No 28424

S SIDDIQUI & AZHAR ALI KHAN

CASHEW NUT SHELL LIQUID IS HEATED WITH BHILAWAN shell liquid or bhilawan nuts at temperatures between 200° and 350 C The heating may be with aeration and should preferably be in contact with sulphur or a metal whose melting point is below 1 000°C The metal may be substituted by its alloy or amalgam or any of its oxygen sulphur or halogen-containing compounds The resulting drying product can be used for the manufacture of lacquer varnishes stoving enamels waterproofing electric insulating and plastic compositions or like materials

Examples — (I) 100 parts by weight of cashew nut shell liquid and 25 parts of bhilawan shell liquid are mixed and heated for about 4 hr in contact with tin at 300° to 350°C

(II) 100 parts by weight of cashew nut shell liquid and 100 parts of bhilawan nuts are heated at a temperature of 300° to 350°C for about 3 hr the liquid portion is separated by straining and reheated for about 4 hr with aeration and in contact with tin

CONVERSION OF BHILAWAN SHELL LIQUID

Patent No 29051

S SIDDIQUI & AZHAR ALI KHAN

RESINS RESINOLS OR OILS ARE ADDED TO BHILAWAN shell liquid or to the converted drying product of bhilawan shell liquid or to the vegetable oil extract of bhilawan nuts and the mixture is heated usually for 6 to 8 hr at temperatures varying from 150° to 320°C Addition of one or more of the following driers to the mixture improves the speed of conversion and the drying properties of the resulting products oleates stearates acetates and other organic or inorganic salts oxides and sulphides of metals such as manganese cobalt and lead The ingredients are heated alone or in contact with metals or their alloys or amalgams or their oxygen sulphur and halogen-containing compounds

Example — 500 gm of oil like linseed castor neem groundnut or a mixture of the oils are added to 500 gm of bhilawan shell liquid and this mixture is gradually heated to 300°C and maintained at this temperature for 6 to 8 hr in contact with tin Instead of oil the same quantity of pitch asphalt bitumen or the like may be added The resulting product is a solid resin soluble in hydrocarbon solvents

Patent No 29938

S SIDDIQUI & AZHAR ALI KHAN

Bhilawan shell liquid is heated with sulphuric acid or sulphonated products such as methyl sulphate or sulphonated oils e g sulphonated castor oil Other resinous materials or synthetic resins may be incorporated The amount of sulphuric acid or sulphonated products may vary from 3 to 20 per cent by weight of the bhilawan shell liquid The heating is conducted at a temperature of 100° to 120°C for 3 to 6 hr The resulting product varies in its consistency and characteristics according to the duration of heating from a soluble semi solid or solid to an insoluble brittle and thermoplastic state It can be used in the manufacture of lacquer varnishes stoving enamels waterproofing electric insulating and plastic compositions or like materials

Patent No 38062

S SIDDIQUI

Bhilwan shell liquid is copolymerized with turpentine by treatment with nitric acid Commercial nitric acid may be used or nitric acid may be produced *in situ* by reacting saltpetre with hydrochloric acid The copolymerized product is thoroughly washed with water and the acid free semi solid resinous mass is dissolved in a mixture of benzene and turpentine or the like solvents for the manufacture of air drying varnish compositions enamels or the like

Example—40 parts of bhilawan shell liquid are dissolved in 60 parts of turpentine in an acid resisting enamelled vessel kept below 50° to 60°C 80 parts of commercial saltpetre and 120 parts of commercial hydrochloric acid are added alternately in small quantities stirring the contents The entire operation takes about 4 hr to complete The resulting semi solid polymerized product is washed and further treated as above

Patent No 38064

S SIDDIQUI & D C DHAR

Vegetable oils such as groundnut oil or linseed oil are copolymerized with bhilawan shell liquid, and turpentine or rosin (or oleo resinous materials) by treatment with nitric acid To make the reaction milder nitric acid may be produced *in situ* in the reaction mixture by the action of concentrated hydrochloric acid on saltpetre The acid is first mixed with bhilawan shell liquid and the saltpetre is then added to the mixture in small proportions The resulting plastic mass is washed with water pressed dry and dissolved in a mixture of benzene or white spirit and turpentine and filtered to remove any undissolved particles Varnishes prepared can be employed for waterproofing textiles or imparting artificial leather finishes to cloth paper or cardboard

Learned Societies & Science Progress

THE encouragement given to the development of scientific societies in India to which reference is made in the Report of the Department of Scientific Research for 1949-50, constitutes an enlightened recognition of the rôle of learned societies in the promotion of science in this country. In the continuing growth of science non-official academies and specialist societies have played a notable part directly by facilitating the meeting of specialists to discuss research problems and by serving as centres for collecting and disseminating scientific information, and indirectly by linking the efforts of universities and research institutions, fostering creative thought and checking the trend towards isolation and exclusiveness among scientists consequent on increasing specialization.

The development of modern science in India runs parallel to the growth in the number and activity of the learned societies of the country. Disinterested and objective inquiry into the realms of natural knowledge — which is science — is facilitated as much by experiment as by discussion among those engaged in similar pursuits. Indeed, the importance of discussion as a desideratum for scientific progress was brought home to the natural philosophers of Europe in the seventeenth century, as a study of the history of the foundation of the Royal Society, London, would show. Learned societies provide an index of the vitality of the scientific movement in any country, and their activities faithfully reflect the qualitative and quantitative features of scientific research and development.

History records that science began with comprehensive inquiry into natural phenomena, and progressed when particular problems were isolated, defined and inquired into. Even so, in the evolution of scientific societies, the first phase was the foundation of learned bodies which comprehended the whole realm of Nature. This was followed by the foundation of specialist societies with restricted fields of inquiry, which, in turn, gave rise to others with still narrower and more restricted fields. History also reveals that the absorbing and penetrating inquiries into specialized branches of knowledge, invaluable as they are for the understanding of Nature, have in them the germs of isolation, and at some stage the urge for collaboration with allied bodies becomes assertive. The foundation of societies designed to co-ordinate the activities of specialist organizations and at the same time, to initiate studies into "border" sciences and neglected fields so that the ever widening frontiers of science may be uniformly cultivated becomes a necessity. These phases are clearly discernible in the evolution of learned societies in India.

The first learned society organized to stimulate interest in science was the Asiatik Society of Bengal founded in 1784 by Sir William Jones. Its objectives were the study of "Man and Nature, whatever is performed by the one or produced by the other". Invested with so expansive a field for its labours, the Society did yeoman service to the cause of science in India. Within a century after its establishment, it had fulfilled its ideals by providing "a commodious house for scholars, the making of a library of a collection of ancient coins and moulds, of a collection of pictures and busts, and the formation of Archaeological, Ethnological, Geological and Zoological collections, or Museums. In addition, the Asiatik Society published 354 volumes of works of various kinds."

During the early years of the revival period, as investigation and discovery were gaining momentum other societies came into existence Among them were the Madras Literary Society an auxiliary of the Royal Asiatic Society of Great Britain & Ireland (1833) the Royal Agri-Horticultural Society of India with its beginnings in 1820 and The Bombay Natural History Society, established in 1833 The last-named society, through its well-known journal, has made distinguished contributions to the progress of science in India Medical science was represented by the Medical & Physical Society The Indian Association for the Cultivation of Science was established at Calcutta in 1876, and the Anthropological Society of Bombay in 1886

With the beginning of the twentieth century, progress of scientific research in India was greatly stimulated by the establishment of a large number of research institutions all over the country Increasing numbers of young men and women took to the study of science and visits to foreign countries for under-graduate and post-graduate studies in science became frequent Research under the Scientific Services and in the departments of the Government made rapid progress The universities founded in the earlier century established post-graduate studies in science Research in all the departments of science was intensified and a large number of scientific societies came into existence In the words of Sir Lewis Fermor "In the twentieth century, we have entered on a new stage in the development of scientific research in India — a period characterized by the formation of numerous specialist scientific societies and numerous Government research institutes" Among the societies may be mentioned the Mining & Geological Institute of India (1906), the Indian Mathematical Society (1907), the Institution of Engineers India (1920), the Indian Botanical Society, with peripatetic headquarters (1921), the Psycho-Analytical Society, Calcutta (1922), the Indian Chemical Society, Calcutta, and the Geological, Mining & Metallurgical Society (1924), the Indian Psychological Association (1925), the Indian Physical Society, Calcutta, and the Biochemical Society (1934), the Indian Ceramic Society (1928), the Indian Statistical Institute (1931), the Indian Society of Social Science and the Indian Physiological Society (1936), the Entomological Society of India (1938), the Zoological Society of India (1939), Indian Society of Genetics & Plant Breeding (1941), Horticultural Society of India (1942), the Phytopathological Society (1947) the Association of Psychiatry (1947), the Association of Indian Geographers (1947), the Indian Institute of Metals (1947), the Aeronautical Society of India (1948) and the Indian Dairy Association (1948) Among the societies with more restricted geographical scope may be mentioned the Bihar & Orissa Research Society Patna (1915) Banaras Mathematical Society Banaras (1918), the Anthropological Society (1933) the Botanical Society of Calcutta (1935), the Botanical Society of Bengal and the Gujarat Research Society (1936) All these societies had more or less similar objectives viz. the promotion of a particular branch of knowledge in all its aspects the publication of a journal relating to its special field diffusion of knowledge among the public facilitating contacts among members and encouraging original investigations

The coming into existence of many centres of scientific research separated by long distances over the vast sub-continent of India, created an "isolation" among scientists which was sought to be removed by organizing a common forum Impressed by the "great lack of scientific intercourse in India" and realizing that 'scientific research in the country might be stimulated if an annual meeting of the workers on the lines of the British Association for the Advancement of Science could be arranged", Professors P S McMohan and J L Simonsen took the initiative in organizing the Indian Science Congress Association in 1914 with headquarters at Calcutta They foresaw that "not only would the direct personal contact and association of actual workers be of great value, but also that the general public would be brought to realize the importance and value of scientific research" The Association was to hold an annual meeting, sectional or otherwise, in the more populous Indian towns, where papers might be read and discussed and the proceedings be published in the form of an annual report Their expectations have been fully realized and, during the four decades of its existence, the Association has developed into a mighty organization under whose auspices Indian and foreign scientists now meet to discuss scientific problems and exchange ideas It also brings scientists into contact with others who, following administrative or other careers or belonging to some other learned professions, seek opportunities to imbibe new ideas and knowledge, and to make their own contributions in some department or other The Indian Science Congress Association has established international scientific collaboration not only with similar societies within the Commonwealth, but also with many European and American societies.

Important as the advent of the Science Congress Association was, there still remained the need for bringing specialist associations together and to counteract fissiparous tendencies " so as again to bring men of science and other branches of learning back to a common fold, providing for a free exchange of views,— a result that can be secured either on a comprehensive basis enabling the co-operation of all branches of learning or at least of all branches of science, or upon a compartmental plan in which allied groups of scientists are brought together " There was also the need for a central body to represent the learned societies and act as their spokesman at conferences and international gatherings.

During the quinquennium 1930-35, several Academies came into existence The United Provinces Academy of Sciences was founded at Allahabad and was re-named the National Academy of Sciences (India) in 1936 The Indian Academy of Sciences was started with headquarters at Bangalore in 1934 The National Institute of Sciences of India was established in 1935, and had for its objects, among others, the co-ordination between scientific academies, societies, institutions and Government scientific departments and services. The National Institute of Sciences received Government recognition in 1945 as the premier scientific organization in the country It occupies a position relative to academic science on the one hand and Government organizations on the other, corresponding to that of the Royal Society of London or the National Academy of Washington. The Institute acts as adviser to the Government on all scientific matters, secures and manages funds and endowments for the promotion of science, and publishes transactions, proceedings and Indian science abstracts

This brief survey of scientific societies in India lays no claim to be exhaustive Many new societies continue to be founded to meet specific requirements as they arise As the bounds of knowledge expand, new fields come into prominence, drawing teams of workers to cultivate them Science in India is on the march , stimulated by freedom and encouraged by an enlightened National Government, significant developments are expected in scientific research, both in its fundamental and applied aspects, which will profoundly influence the activities of learned societies in India

Characteristics of the Ionosphere over Calcutta (May 1950)

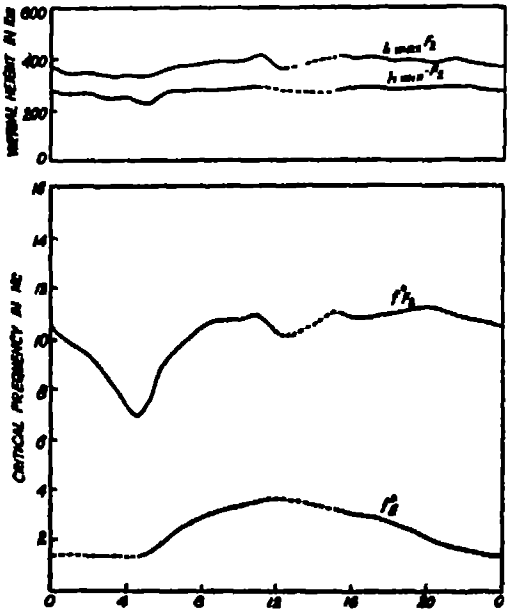
S S BARAL, R. K. MITRA, D C CHOUDHURY, R. B. BANERJEE & A P. MITRA

Ionosphere Laboratory, Institute of Radio Physics & Electronics, Calcutta

THE following are the ionospheric data observed at Calcutta for the month of May 1950

Fig 1 represents the mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of August 1950 Table I gives the different occasions during routine observations when sporadic E ionization was observed and the values of the corresponding penetration frequencies and heights

Sporadic E ionization was found to occur frequently during the afternoon and night and the frequency was found to be greater in this month than in the previous one. It may be noted that thunder-clouds were more frequent in the evening hours in this month Echoes from both regions E and F_2 suffered high absorption from 10 a.m. to 3 p m during almost every day in this month.



(5 HOURS 54 MINUTES AHEAD OF G.M T.)

FIG 1 — MAY 1950

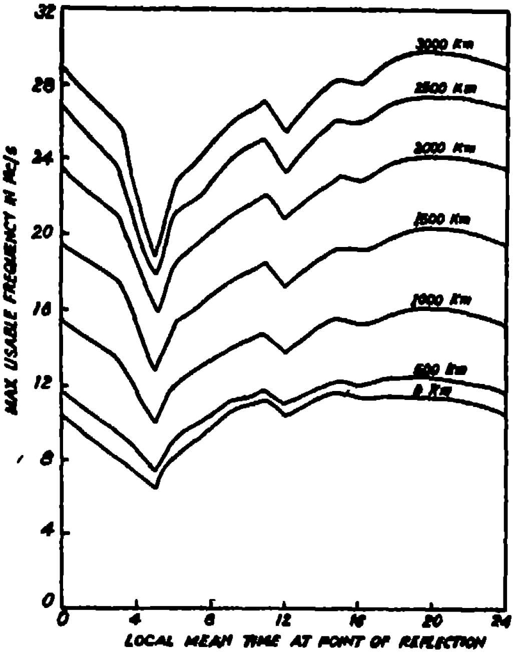


FIG 2 — PREDICTED M U F VIA F_2 LAYER AUGUST 1950

TABLE I

MONTH & YEAR	DATE	HOURS L M T	$f^{\circ}E_s$ Mc	$^{h}E_s$ Km
May 1950	1	18 00	3 30	120
		19 00	4 00	120
		20 00	5 00	120
		21 00	2 50	105
		22 00	2 60	105
	3	21 00	3 60	105
		23 00	3 50	90
	4	00 00	2 60	90
		01 00	3 80	90
		02 00	3 20	90
		20 00	7 00	120
		22 00	4 00	120
	5	23 00	3 90	105
	6	00 00	4 20	105
	8	16 00	4 00	120
		18 00	2 70	120
		20 00	3 20	120
		21 00	4 00	120
	9	07 00	4 00	120
		20 00	3 40	120
	10	00 00	4 00	105
		06 00	3 50	105
		07 00	3 00	105
		09 00	5 00	120
	12	00 00	4 00	105
		01 00	3 25	90
		05 00	3 00	90
		18 00	3 65	120
		19 00	4 60	120
		20 00	3 60	120
		21 00	3 50	105
	13	01 00	3 50	90
		02 00	3 00	90
		03 00	3 00	90
	16	15 00	6 50	135
		16 00	6 50	135
		17 00	6 00	135
		18 00	7 20	135
		19 00	6 40	120
		20 00	3 50	105
		21 00	3 30	105
	17	02 00	2 65	90
		03 00	4 05	90
		04 00	4 25	105
		20 00	6 40	105
		21 00	7 50	135
May 1950	17	22 00	7 50	135
		23 00	7 50	120
		23 00	7 10	100
	18	00 00	6 25	105
		01 00	4 00	90
		16 00	4 95	120
		17 00	4 95	120
		19 00	6 00	120
		20 00	3 25	120
	19	08 00	8 20	135
		09 00	9 35	135
	23	20 00	2 90	105
		21 00	6 00	120
	24	04 00	5 05	120
		19 00	5 40	135
		20 00	5 40	120
		21 00	4 80	120
		22 00	4 00	120
	25	11 00	8 00	150
		17 00	5 00	135
		19 00	3 80	120
		21 00	3 20	105
	26	21 00	3 70	105
		22 00	4 00	105
		23 00	3 50	105
	27	00 00	3 20	90
	29	16 00	4 70	120
		17 00	4 40	120
		18 00	3 20	105
		22 00	3 30	105
		23 00	3 85	90
	30	00 00	4 20	90
		01 00	4 95	105
		02 00	4 70	105
		03 00	3 85	90
		17 00	5 20	120
		19 00	4 90	120
		20 00	5 00	120
	31	00 00	9 80	105
		02 00	3 45	90
		03 00	4 30	90
		04 00	3 45	105
		19 00	6 80	120
		20 00	6 80	120
		21 00	4 60	105
		22 00	4 50	105
		23 00	6 10	105

Chelation & Isomeric Change*

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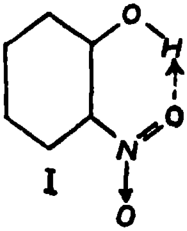
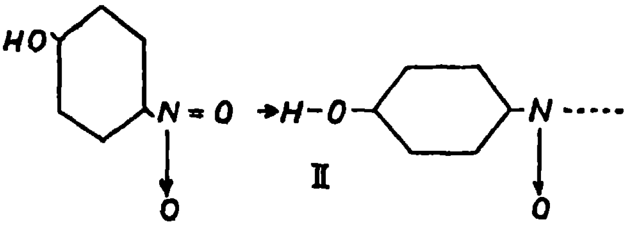
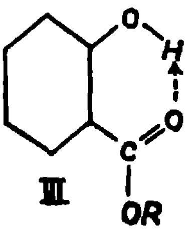
Department of Chemistry, Delhi University

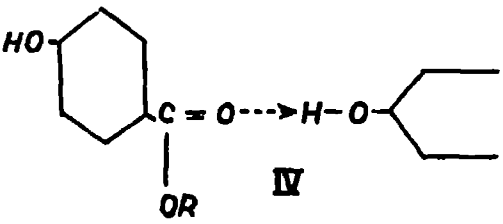
CHELATION in aromatic hydroxy compounds has been known to have marked effect on the properties of the compounds For example *ortho*-nitro phenol (I) which is chelated has a markedly lower melting point, higher steam volatility and greater solubility in anhydrous solvents than the *para* isomer (II) Further, the *ortho* compound is unassociated whereas the *para* is associated Besides these properties in the case of *ortho*-hydroxy carbonyl compounds like methyl salicylate (III), a marked colour is produced by alcoholic ferric chloride which is not given by the *para*-hydroxy compounds (IV) Further the *ortho* hydroxyl is resistant to methylation unlike the *para*-hydroxyl group The behaviour of a number of derivatives (V) of resacetophenone resorcylic acid and aldehyde in several reactions lends support to the suggestion of Baker that chelation gives rise to a fixation of aromatic double bonds (see *Fixation of Aromatic Double Bonds* by Rangaswami and Seshadri[1]) The present discussion relates to the discovery of the important part played by chelation on the stability of the molecular structures of flavanones and chalkones and their interconversion and the light it throws on the constitution of a few typical compounds

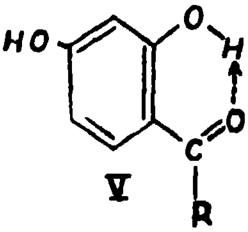
In the course of the study of the flavanone glycosides, naringin (VI) and butrin (VIII), a remarkable difference was noticed in their behaviour when subjected to acid hydrolysis, whereas the former yields a single aglucone, naringenin (VII) which gives all the reactions of a flavanone the latter, under the same conditions forms a mixture of aglucones consisting of the flavanone, butin (IX) and the chalkone butein(X) A similar difference in behaviour is exhibited by the two isomeric flavanones, butin and naringenin, when heated with mineral acids or dissolved in alkali and reprecipitated with acids The first undergoes partial change into the chalkone butein whereas the second is unaffected, The difference could be attributed to the presence of a 5-hydroxyl in naringin and naringenin and its absence in butrin and butin This explanation was fully supported by a study (1) of the methylation products of the above four compounds obtained by


I


II


III


IV


V

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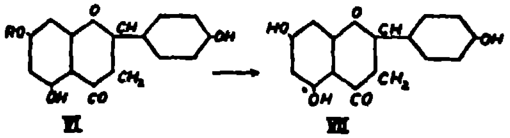
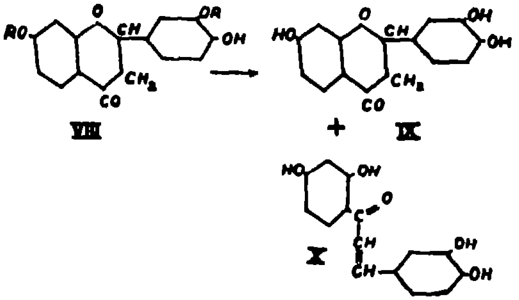
* A contribution to a symposium held during the Indian Science Congress at Poona in January 1950

using varying molar proportions of dimethyl sulphate and (2) of a number of simpler flavanone derivatives[3]. The flavanone structure is not stable when the 5-hydroxyl is non-existent or is methylated.



VI VII

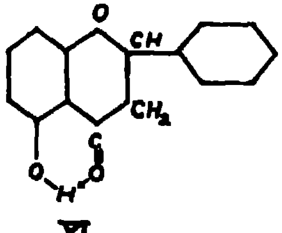


VIII IX X

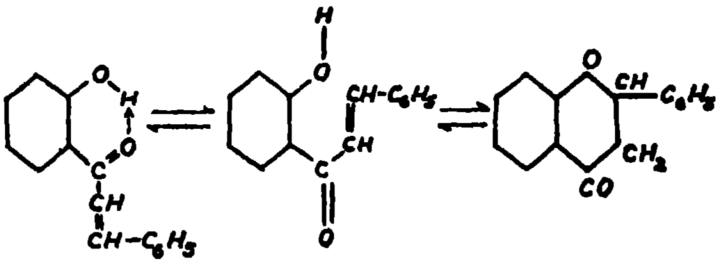
The above mentioned significant influence of the 5 hydroxyl group is attributed to the existence of chelation involving this hydroxyl and the neighbouring carbonyl group of the flavanone molecules as shown in (XI). When it is absent the flavanones and the corresponding chalkones exist in equilibrium in an acid or alkaline medium and are capable of undergoing interconversion (XII to XIV). That chalkones are largely chelated is amply borne out by their properties and thus structure (XII) will correctly represent them. The existence of the non chelate form (XIII), though in small amounts is indicated by the study of the Raman effect of *ortho*-hydroxy carbonyl compounds[3]. This was originally explained by giving the trans structure to the hydroxyl alone. It seems to be more correct to consider that the reorientation of the CO group is also involved as shown in (XIII). The presence of a 5-hydroxyl adds more stability to the flavanone structure by the formation of an additional chelate ring as shown in (XI). Even if the flavanone ring opens, for instance, in an alkaline medium, the concerned groups are not able to move far enough to yield a stable chalkone. On the other hand, whatever alternative constitution the chalkone form takes in this case, it is favourable for quick conversion into the flavanone.

A consequence of the above considerations is that chalkones with hydroxyls in the 2- and 6-positions should be extremely unstable and should have very little chance of existence particularly in the presence of acids and only the corresponding flavanones should be obtainable. Such chalkones have not been found to occur in nature though the flavanones are fairly common. On the other hand butein in which this structural feature does not exist occurs free[4]. An interesting verification of the above conclusion was provided by the study of despedicellin and dihydropedicinin which are important derivatives of the chemical components of *Didymocarpus pedicellata*.

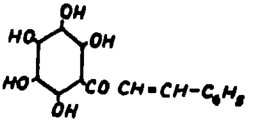
Despedicellin was obtained by the action of hydriodic acid on the chalkones pedicellin pedicin and pedicinin. It was therefore given the chalkone structure (XV). A substance of this constitution would normally be expected to have a bright red colour but despedicellin is only pale straw yellow. Its colour would suggest that it is a flavanone (XVI) a structure which is in accordance with the conclusions recorded in the above paragraph. The position is quite similar in the case of dihydropedicinin obtained by the reduction of the chalkone pedicinin using stannous chloride



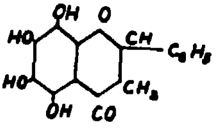
XI



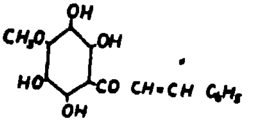
XII XIII XIV



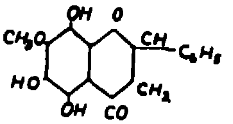
XV



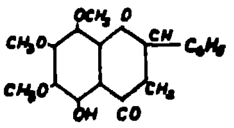
XVI



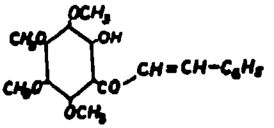
XVII



XVIII



XIX

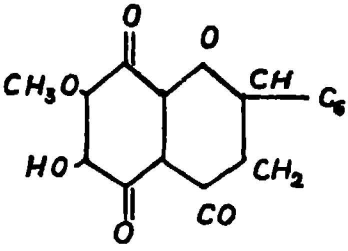


XX

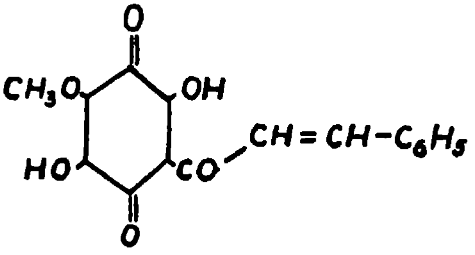
and hydrochloric acid Though it was originally given the chalkone formula (XVII) the lack of prominent colour even here would indicate that dihydropedicinin is also a flavanone (XVIII) That these two compounds have the flavanone structure was established by the detailed study carried out by Rao Rao and Seshadri[5] They undergo partial methylation with excess of diazomethane yielding 5-hydroxy-6 7 8 trimethoxy flavanone (XIX) whose constitution was definitely established If they were chalkones a tetramethyl ether (XX) would have resulted since only one phenolic hydroxyl could be protected in this reaction by the neighbouring carbonyl group Dihydropedicinin undergoes oxidation with *p*-benzoquinone to form allopedicinin (XXI) which is definitely different from pedicinin (XXII) and whose constitution was also definitely established

Yet another unequivocal evidence was provided by the determination of active hydrogen atoms using magnesium methyl iodide Despedicellin gave evidence for the presence of only four hydroxyl groups in its molecule and dihydropedicinin for only three These independent proofs of the constitutions of despedicellin and dihydropedicinin add support to the original theory that chelation provides stability to the flavanone structures

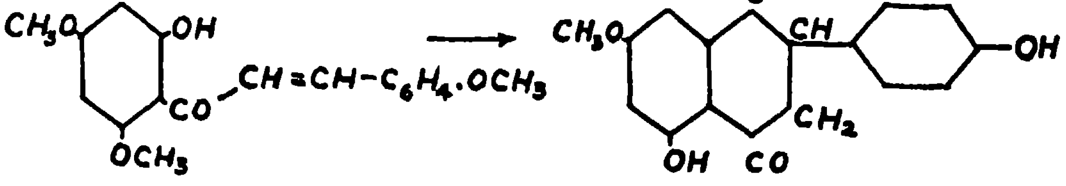
Based on the same principle is the recent preparation by Narasimhachari and Seshadri[6] of sakuranetin (XXIII) by the partial demethylation of 2-hydroxy 4 6 4'-trimethoxy chalkone (XXIV) using hydrobromic acid The stability of the resulting flavanone is an important consideration in the preparation of this substance in a pure condition



XXI



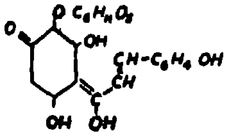
XXII



XXIV

XXIII

It may be appropriate to refer here to the constitution of carthamin and *iso*carthamin, the glucosidic pigments of safflower Miss Kuroda[7] gave them the structures (XXV) and (XXVI) based on the absence of certain colour reactions If they are chalkones, as most probably they are, in view of the general principles established in the foregoing paragraphs, these formulations may not be correct and may require revision with regard to the position of the sugar unit One of the two *ortho* positions, either 2 or 6 is more likely, thus giving greater stability to the chalkone form This also agrees with the observation that as soon as the glucose unit is removed by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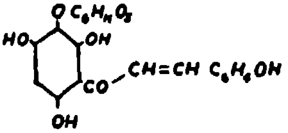
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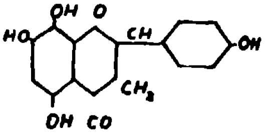
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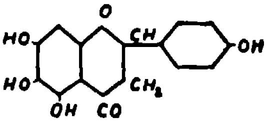
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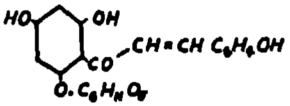
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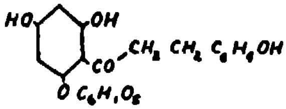
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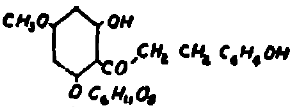
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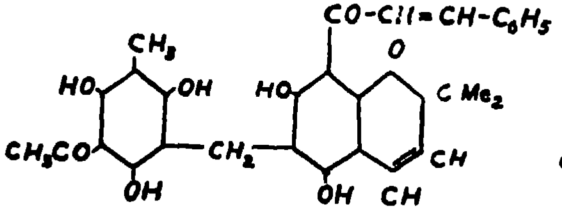
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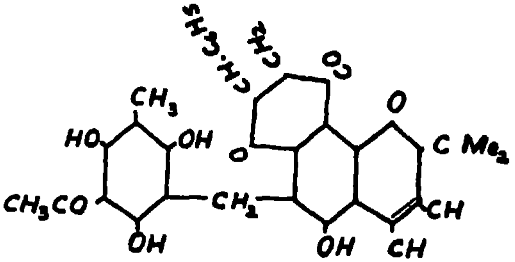
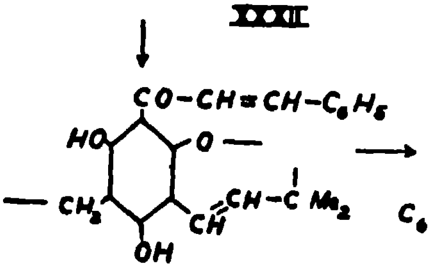

XXXIII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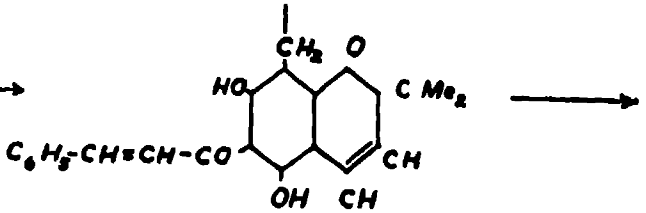
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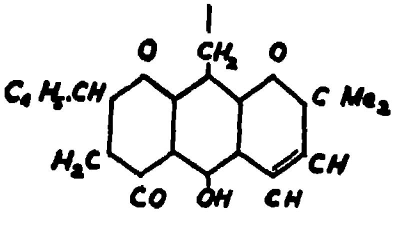
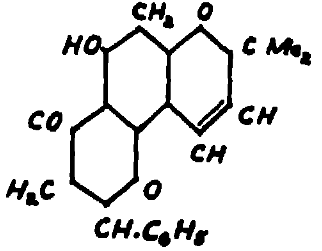

XXXIV

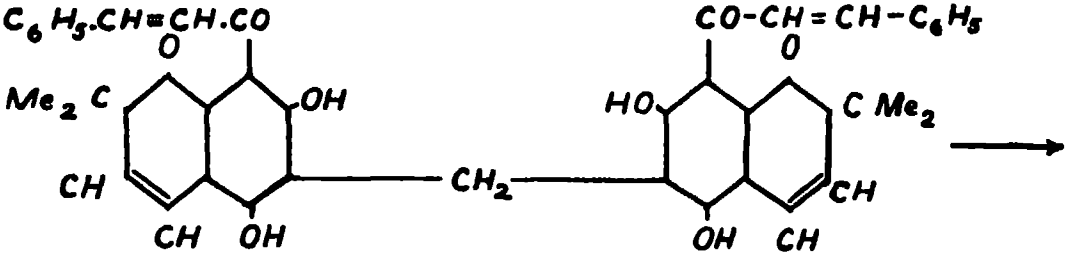
or


XXXV

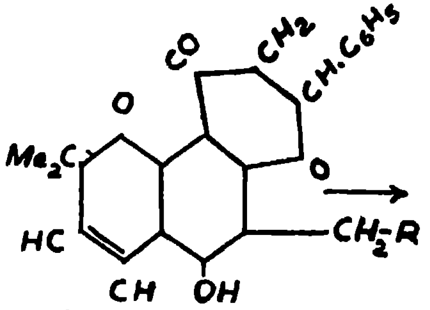
hydrolysis the two isomeric flavanones, carthamidin (XXVII) and *iso*carthamidin (XXVIII) are produced. Analogous 2-glucosides are found in *iso*salipurposide (XXIX)[9] phloridzin (XXX)[9] and asebotin (XXXI)[10].

Another interesting application of the above discovery of the effect of chelation is in connection with the rottlerin *iso*rottlerin change[11]. Rottlerin (XXXII) is the important colouring and anthelmintic principle of the *kamala* dye. Its isomerization into *iso*rottlerin (*iso*allorottlerin) was observed by a number of workers. Brockmann and Maier[12] considered that it consisted in the cyclization of the chalkone form (XXXII) into the corresponding flavanone (XXXIII). McGookin, Robertson and Tittensor[13] later showed that it was not a simple ring closure but involved further an interchange of the position of the cinnamoyl and substituted phloroglucinol residues (formula XXXIV or XXXV). They expressed the view that the first stage of the reaction is the conversion of rottlerin into the intermediate (XXXVI) by the opening of the chromene ring and this is followed by the reformation of the latter to produce (XXXVII) which is strictly analogous to rottlerin and is termed allorottlerin. At the same time the chalkone is cyclized to the flavanone system with the production of either (XXXIV) or (XXXV) which was appropriately designated *iso*allorottlerin.

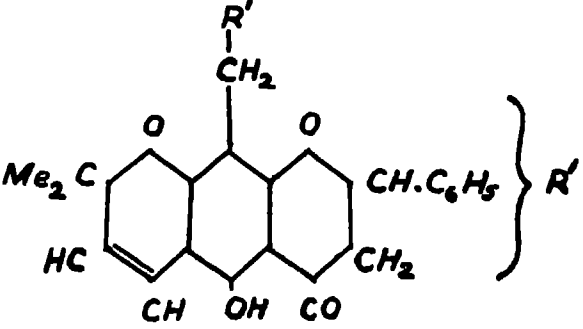
The important point that is definitely established by the work of McGookin *et al* is the shift of the chromene ring. But it was not clear as to why it happened and when. As a result of the discovery of the effect of chelation on the stability of flavanones it is now possible to explain these and also make a choice of the alternatives for the constitution of the final product. If there were no shift of the chromene ring and only the flavanone ring closure took place, a 7-hydroxy flavanone derivative (XXXIII) would have resulted. But on account of the rearrangement, a 5-hydroxy flavanone derivative is obtained and this represents a more stable structure. The reason for the *iso*allorottlerin change would, therefore, appear to be that thereby the molecule reaches greater stability. If this perfectly reasonable position is accepted, it then follows that the chromene ring shift takes place only after the initial flavanone ring closure to (XXXIII) and



XXXVIII



XXXIX



XL

hence the constitution of the final product *iso*allorottlerin should be represented by (XXXIV)

A closely analogous substance suitable for this study of isomeric change is rottlerone (XXXVIII) the main degradation product of rottlerin Its constitution was established by Robertson and co-workers and it has all the structural features required for this test It undergoes isomeric change almost completely by boiling in acetic acid solution for 1 hr The deep red colour of rottlerone disappears and a pale yellow product is obtained in good yield For it the name *iso*allorottlerone is suggested (Rao and Seshadri[11]) Its properties agree with the 5 hydroxy flavanone structure (XL) the intermediate produced by simple flavanone ring closure being represented by (XXXIX)

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Obituary — Dr. Roland Victor Norris (1888-1950)

Dr Roland Victor Norris died at Port Shepstone South Africa on 28th April 1950 at the age of 62

Dr Norris went to South Africa in November 1949 on a holiday and was due to return to the Tea Research Institute of Ceylon of which he had been the Director since 1929 His death is a sad loss to the Institute he served so well and a personal misfortune to his many friends

After graduating from Manchester University Dr Norris became private assistant to Professor W H Perkin Moving to the Lister Institute of Preventive Medicine London in 1910 he joined Professor Arthur Harden s School and took part in the classical researches on the mechanism of alcoholic fermentation by yeast enzymes for which work he was eventually awarded the D Sc degree of the London University In 1912 during his career at the Lister he was elected to a Beit Memorial Fellowship

Dr Norris's long career in the East began in 1914 when he accepted the post of Physiological Chemist at the Imperial Bacteriological Laboratory in India His first administrative experience was gained in the Indian Army in which his administrative abilities were soon recognized after a brief period of active service in 1915

From 1918 onwards Dr Norris gradually turned towards agricultural research first becoming Agricultural Chemist to the Government of Madras As Professor of Biochemistry in the Indian Institute of Science Bangalore from 1924 to 1929 he and his research students were largely occupied with biochemical problems relating to agricultural subjects such as soils plants manures the lac industry and the spike disease of sandalwood

In 1929 Dr Norris was appointed to the Directorship of the Tea Research Institute Ceylon when the construction of the permanent quarters at St Coombs had just started The Institute has grown from its foundation on St Coombs Estate to its present status under his guidance and will be a living memorial to his industry so long as it exists

R V as he was known to his colleagues was by no means a pedant He was a widely travelled and well read man of varied interests European Indian and Ceylonese colleagues of two generations will remember R V with affection Many members of the tea industry will remember Roland Norris either as a personal friend or as a personality

J L

Diamond & Carbide Dies — Literature Report No. 6

B S SRIKANTIAH & B R NIJHAWAN
National Metallurgical Laboratory C S I R Jamshedpur

MANY fundamental changes and considerable improvements in methods and equipment for drawing wires have taken place in the past three decades The use of diamond dies for drawing very fine wire has notably increased and the introduction of synthetic carbide and hard metal dies is a significant feature of recent years The finish and quality of the wire produced has been improved Increased drawing speeds are possible now and most important of all is the successful introduction of the heavy multiple die drawing bench and the continuous wire drawing mill These developments have been possible because of the long life and reliable performance of the carbide composition die However these advances have created special problems particularly in regard to the making maintenance and servicing of dies

Diamond Dies

Until very recently the making of diamond dies of very fine bore was a closely guarded secret The outbreak of last war stopped the export of the dies from Europe and the large demand created by the war effort led to their manufacture in the U K and the U S A[1]

The diamonds used for wire drawing dies are what are known as industrial diamonds Three kinds are generally used (1) carbons (2) Bortz and (3) Ballas Of these the carbons being porous are not suitable The Bortz are impure diamonds of white brown or black colour and possess high shock resistance They are obtained from Brazil and South Africa and are the most useful stones for industrial purposes Ballas are composed of radial clusters of minute diamond crystals Amongst the Bortz the well known are the Cape Round Bortz and the Brazilian Bortz

The Ballas are priced high and fetch the same price as the black diamonds from Brazil The better grades of carbonades and Ballas sell for $ 20 to $ 100 a carat Good quality Bortz diamonds sell for about $ 5 to $ 10 a carat while diamond powder sells at about $ 2 per carat

The diamonds must be free from imperfections such as spots feathers inclusions bubbles cracks etc as these seriously reduce the life of a die especially appearing in the taper hole region

For producing fine bore dies a rhombic dodecahedral stone is preferred An octahedron is used for large bore dies Stones exhibiting twinning are not used for dies as the bond between the twins is weak and invariably leads to early die failure through cracking

The first rough selection of the stones is usually made with the aid of a hand lens in strong daylight and the final selection is done after a microscopic examination Many stones exhibit internal stresses when examined under polarized light and it is desirable that only stones which are substantially free from stress should be used

The weights of diamond required for making dies for a given diameter of wire are given in Table I[2]

TABLE I

WIRE DIA TO BE DRAWN mm	WT OF DIAMOND GRS
0 05 to 0 16	⅛
0 16 to 0 19	¼
0 19 to 0 23	⅜
0 23 to 0 27	½
0 27 to 0 31	¾
0 31 to 0 41	1
0 41 to 0 45	1¼
0 45 to 0 50	1½
0 50 to 0 55	1¾
0 55 to 0 61	2
0 61 to 0 65	2¼
0 65 to 0 70	2½
0 70 to 0 75	2¾
0 75 to 0 80	3
0 80 to 0 90	3½
0 90 to 1 00	4
1 00 to 1 10	4½
1 10 to 1 20	5
1 20 to 1 30	6
1 30 to 1 40	7
1 40 to 1 50	8
1 50 to 1 60	9

The holders for the stones are made of metal Low temperature alloys have been developed for fastening the diamond in the holder Brass and steel are commonly used Monel metal[3] has also been used and it is reported to be ideal for this purpose Taylor[4] has described the various methods of mounting diamonds in metal holders The earlier methods viz mechanically tightening the diamond in a steel block with a strip of copper foil casting etc are not quite satisfactory

Investigations carried out at the *General Electric Company Research Laboratories* U S A have shown that employing a carbide cement composition such as carboloy manufactured by the *Carboloy Co Inc* (similar to a composition known as *Widia* in Europe) provides intimate contact between the carboloy and the diamond In wire-drawing dies[3] where a single stone is set the use of carboloy in preference to any other alloy is recommended for the following reasons (1) coefficients of expansion of diamond and of carboloy are very nearly the same and carboloy does not undergo plastic deformation and (2) good thermal contact is obtained between carboloy and diamond which helps to dissipate the heat generated during wire drawing operation

Manufacture of the Die

The appearance of a typical diamond die can be seen in perspective in Fig 1 The die can be divided into several zones and the profile of the die varies according to the metal to be drawn Typical profiles for dies for drawing copper bronze steel and tungsten wires are given in the British Standard Specification War Emergency British Standard 1168 (1944)

The most important zone in the die is the reduction zone and is so designed as to avoid excessive wear

The various processes employed in producing a die and the different parts of the prepared stone are described with reference to Fig 1

1 *Drilling Faces* — The two flat parallel surfaces ground on the diamond at right angles to the drilling axis of the die aperture and referred to as drilling faces

2 *Two other flat surfaces* (*viewing windows*) are ground on the diamond at right angles to the first two so that the progress of drilling can be continuously observed

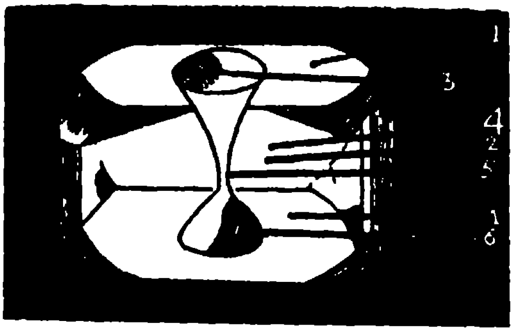

FIG 1 — PERSPECTIVE VIEW OF A PREPARED DIAMOND SHOWING THE PROFILE OF THE DRILLED HOLE (1) DRILLING FACES (2) VIEWING FACES (3) ENTRANCE TO THE DIE (4) APPROACH TO THE BEARING OF THE DIE (5) BEARING OF THE DIE AND (6) EXIT OF THE DIE

3 *The entrance to the die* is referred to as the lubricating cone

4 *The approach to the bearing of the die* is conical in shape and is varied according to the type of the metal drawn

5 *The bearing of the die* determines the size of the wire drawn through it The length of the bearing is varied according to the wire drawing requirements of different types of metal

6 *The Exit of the Die* — The drilling of the diamond calls for exceedingly accurate and careful work The various appliances such as polishing machine drilling lathe etc have been fully described by Dudding and others[5,6] High speed precision methods have also been described by Wall[6] and Zahour[7]

The operations in die production are (1) preparation of diamond powder (2) preparation of diamond for drilling (3) centring and starting the entrance (4) drilling (5) completing the exit (6) mounting and (7) polishing

1 *Preparation of the Diamond Powder* — The lowest quality of diamonds unsuitable for dies are used in the preparation of diamond powder Mechanical methods of crushing are employed to obtain the desired mean particle size The powder is chemically treated to remove impurities and graded up to 300 meshes per linear inch After this the powder is further graded by means of an elutriator (sizes up to 20×10^{-6} metre) For extremely fine sizes (0 5 $\times 10^{-6}$ metre) centrifugal methods are employed

Fig 2 shows the size-quality relationship of 5 grades of diamond powder

2 *Preparation of Diamond for Drilling* — The selected stones are polished and working faces and viewing windows are cut and polished

For polishing the diamond is set in a lead matrix and mounted over a revolving disc driven by an electric motor at *c* 2 500 r p m The disc is of cast iron and impregnated with diamond dust Great care is taken to see that the two working faces are polished exactly parallel to one another

3 *Centring & Starting the Entrance* — The exact position where the diamond is to be pierced is marked on one of the working faces The diamond is then cemented to the chuck on the specially shaped rotating steel head by means of shellac The stage containing the steel head is capable of being rotated through 90° It is first set so that the face of the diamond may be viewed through a vertically aligned microscope The mark made on the face is centred by means of adjusting screws the stage is then turned to a horizontal position and coupled to a fractional horse power motor with foot operated speed control A small lamp is arranged to illuminate the diamond during boring The apparatus (*G E C British Patent Specification No* 544381) is described by Patterson and Leeds On the marked spot an indenture is made by pressing a diamond splinter while the diamond is rotating This first indenture serves as a guide for piercing The depth and shape of drilling are observed through a second microscope

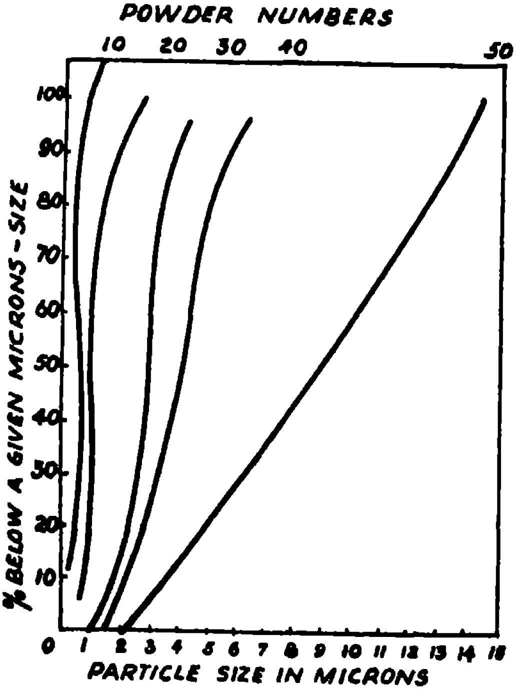

FIG 2 — SIZE QUALITY OF FIVE GRADES OF DIAMOND POWDER

4 *Drilling* — The diamond is pierced for approximately two thirds its thickness on a lathe[8] in which the spindle carries a gramophone needle ground to the requisite size Penetration of the diamond is effected by means of a paste of fine diamond dust and olive oil applied to the end of the needle At the tail stock end two trunnions are provided and on these rests the rod to which the diamond is fixed The diamond is retained in position by the needle entering the hole and is only lightly attached to the rod by vaseline The needle is periodically withdrawn and returned to the hole by the motion of the rod on which the diamond is fixed This horizontal motion of the rod is on the same axis as that of the piercing needle Patterson and Leeds[1] report that for very fine dies it is necessary to control the ratio of the time during which the needle is in contact with the stone to the interval for which it is withdrawn The diamond is then turned round and is drilled to produce the exit

5 *The Exit* — The exit is drilled from the back of the die as before under the microscope with the side already drilled facing downwards The centring is done by means of screws If the faces are not accurately parallel the die will be wedge shaped and an appreciable error is introduced in the axiality of the entrance and exit of the die Lack of co axiality is a common defect in dies and may lead to the drawing of curly wire

A cup shaped hole is made until it meets the channel drilled on the other side At this stage drilling must be made with sufficient care to avoid splintering at the junction

The successive stages in the drilling operation are diagrammatically represented in Fig 3

Electrical drilling methods for superfine wire dies have been developed at the National Bureau of Standards U S A[9]

It is claimed that a good quality fine diamond die from 0·0004 in. to 0 00015 in. in diameter can be produced with a considerable saving of time and cost over the established mechanical methods.

6 *Mounting* — After the drilling operation the die is mounted in a metal casing before it is polished A precision mounting method is described by Patterson and others[6,7]. The casing is a disc, approximately one inch in diameter and a quarter to three-eighths of an inch in thickness. For use in drawing wires at elevated temperatures, steel casing appears to be the best The material employed must be capable of holding the diamond securely for long periods at temperatures as high as 700°C. The die must be so mounted in its casing that the drawing hole is placed centrally and its axis oriented at right angles to the plane of the casing

In mounting, the casing is rested on a heat insulator and the diamond placed in the recess of the casing by means of two tungsten needles, one at the top and the other at the bottom of the hole. On the top of the diamond is placed a pellet of suitably shaped brass alloy and by the application of heat from a ring burner and two side burners, the case, the diamond and the alloy are heated until the alloy becomes plastic It is then pressed by means of a plunger until it fills the space between the diamond and the case Care must be taken to see that the alloy fills the surrounding space perfectly A method[8] of mounting the die in a monel metal casing is given below

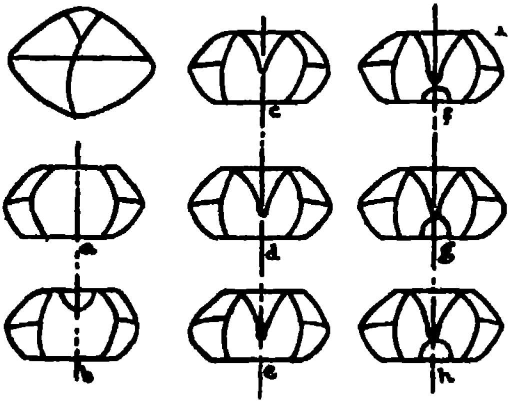

FIG 3 — SUCCESSIVE STAGES IN THE DRILLING OPERATION

A monel metal die casing, which has been recessed, countersunk and drilled, is placed in a metal jig and clamped in position by a molybdenum wire pin locating the drilled hole Steel blocks are used to clamp the casing in position in the jig and the pin is then removed The diamond is then placed in the casing and accurately centred over the aperture by locating the hole in the diamond by the molybdenum pin When viewed through a magnifying glass, the point of the pin appears through the die aperture as a small black dot in the centre of the diamond. The pin is then firmly fixed in position to keep the solder away from the aperture. The usual practice is to set the jig between two electrodes until the correct heat is reached, then the solder is cast in to fill the recess around the stone. The solder used is either silver or bronze and must have a melting point above that of the wire to be drawn Care has to be taken to ensure that no blow holes are left around the stone or around the countersink formed by the pin.

When the die has cooled, the outer surfaces are turned and finished so that the entrance and the exit of the casing are opened out to form a continuous contour with the corresponding portions of the die

7 *Polishing* — For polishing dies of diameter greater than 0·002 in, fine steel needles may be used in combination with diamond powder. In one method the dies are placed in a vertical polishing machine revolving at a high speed while a finely ground non-rotating needle is mechanically oscillated from left to right The swaying action results in producing a smooth entrance by blending the cone at the entrance and the drilled inner cone Sometimes the dies are polished in a hŏrizontal polishing machine where both the die and needle revolve For extremely fine dies tungsten or copper wire impregnated with diamond dust may be employed for polishing

Close grading of the diamond powder plays a very important part in the degree of polish obtaining in the die.

It is necessary to give a high polish to the die to make it perfectly smooth A badly drilled, poorly polished die will produce unevenly drawn, out of round wire and will wear out rapidly Such dies can seldom be recut.

Carbide or Hard Metal Dies — The development of this die has eliminated much of the skill required by the operator However it has given rise to problems in their maintenance The quality and finish of the wire produced by these dies are better and the dies have long life

Swinn[10] and Sandford[11] have described the development of sintered tungsten carbide die The difficulties in the casting of tungsten carbide products were overcome by the application of powder metallurgy The tungsten carbide powder is cemented together with an auxiliary metal like cobalt pressed and sintered The British made product of this type is known as Wimet

Preparation of Tungsten Carbide — The raw material is pure tungstic acid or tungstic oxide Tungsten metal powder obtained by reducing the oxide in an electric furnace is mixed to a homogeneous mixture with 6 per cent lamp black packed into graphite containers and heated in an atmosphere of hydrogen to 1500°C for several hours Tungsten carbide so obtained contains 6 12 per cent carbon

Cobalt powder is obtained similarly Accurately weighed charges of tungsten carbide and cobalt are then mixed in a ball mill The amount of cobalt employed in the mixture varies from 6 to 12 per cent

Sintered tungsten carbide is quite hard and shaping and rough sizing of the article must therefore be carried out prior to sintering

The tungsten carbide and cobalt mixture is pressed in steel dies in a hydraulic press to give die nibs of required size The powder is mixed with a lubricant to prevent the formation of cracks Paraffin wax dissolved in carbon tetrachloride or camphor dissolved in petrol is usually used

Pre sintering before machining is necessary The casting is heated in an atmosphere of hydrogen to a temperature of 750°C to 1 000°C for about 30 min when it attains greater strength and is chalk like in consistency It can then be safely handled in a chuck or a vice and turned or ground with ease

The die nib is machined prior to sintering so that a minimum amount of metal has to be removed after sintering Machining of the die nib is carried out on non automatic lathes using carbide tipped or diamond tipped single point tools

During sintering considerable shrinkage occurs (*e* 20 to 30 per cent) and this must be allowed for during machining by allowing sufficient amount of over size in the nib

The machined nibs are placed in graphite trays or boats embedded in crystalline alumina and heated in an atmosphere of hydrogen to a temperature of 1 400°C to 1 500°C for several hours

Sintered tungsten carbide has great hardness uniform and fine grain size is free from pores and impurities has high transverse and compressive strength and high resistance to abrasion and corrosion

Necessary precautions must be taken against fracture of the die on account of over stresses or shock This is done by giving the die a very rigid steel support

For cutting and polishing cemented carbide dies a machine has been devised by *H J Reusch & Co* It is claimed that in making a finished die from an encased rough nib this machine will perform all necessary operations eliminating manual labour The dies obtained are said to have high polish long life and low power consumption

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Gypsum Deposit near Ran, District Halar, Saurashtra

D R S MEHTA
Geological Survey of India

A GENERAL survey of the gypsum deposits in Saurashtra was undertaken during the field season 1947 48 by the Geological Survey of India and a report was prepared by the author As the deposit near Ran in Navanagar State (now district Halar) proved to be promising it was decided to investigate the same in detail with the help of bore holes The drilling operations were commenced in the area by the end of March 1949 and completed during the third week of July of the same year Hand driven calyx drills (2" core) were used to sink 30 bore holes in the area

The gypsum deposits in Kathiawar occur in the form of selenite veins and as segregations in the bluish plastic clay and marl usually encountered near the base of Gaj limestone beds (Upper Miocene of the Tertiary system) Selenite is a crystalline variety of gypsum which excepting for a small percentage of clayey matter is pure

Bore holes were sunk at intervals of 32 chains of 66 each The deposit as finally demarcated by the bore holes has been mapped with tape and prismatic compass Details of bore hole records of the deposit are given in Fig 1

The average yield of selenite per cu ft of the core has been recorded The nature of the selenite clay and marl bed is such that complete cores are not obtained to arrive at a correct figure for the selenite in the core This difficulty is overcome by comparing the amount of selenite recovered

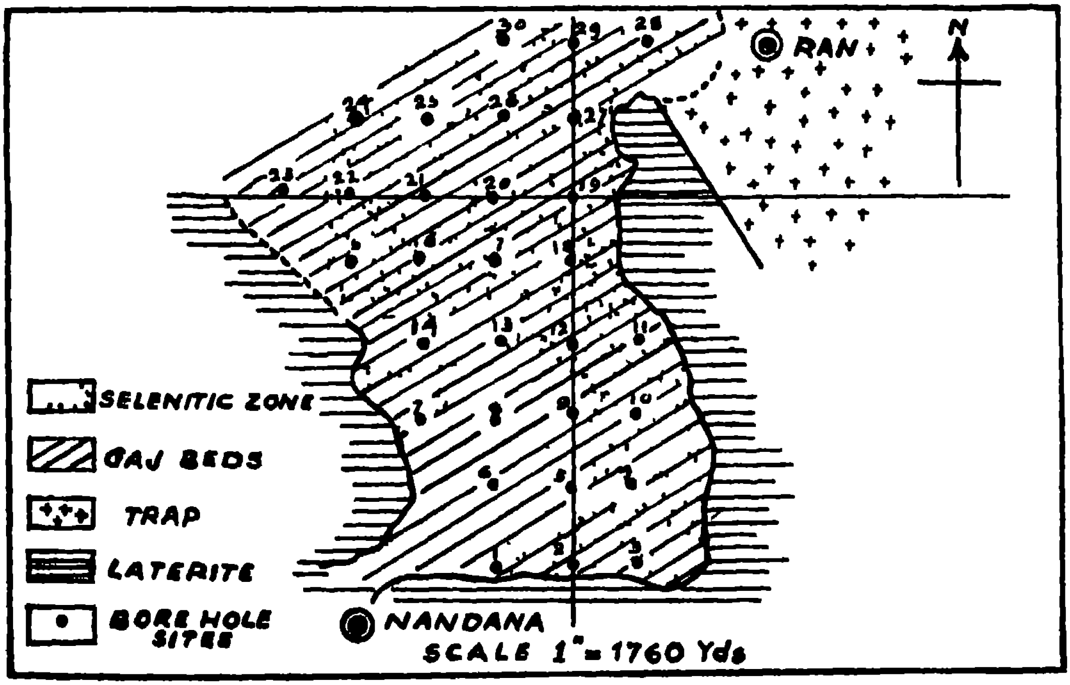

Fig 1 — Gypsum deposit near Ran (Saurashtra) showing bore hole sites

from some of the bore holes and pits located in close vicinity The pits were made during 1949 and the recovery of selenite per 1 000 cu ft were recorded The ratio between the amount of selenite recovered from the pits and from the bore holes has been taken as a constant for estimating from the bore hole data the percentage of selenite available in the clay and marl bed

General Description

The selenitic clay and marl patches occur south west of the village Ran (22°10 69°20 ref Sheet 41F) and is approximately 3 miles in length and a mile and a half in width The thickness of the Gaj beds encountered in the bore holes is of the order of 26 to 70 They are underlain by trap with or without a zone of laterite in between Inliers of the laterite and occasional trap in the Gaj beds are quite common The Gaj beds are throughout almost horizontally disposed but there is a slight increase in the thickness of the formation due westwards suggesting a low dip in that direction

The average yield of selenite for the whole deposit can be taken as 2 tons per 1 000 cu ft of the selenite clay and marl

Reserves

The area covered by the selenitic clay and marl bed as revealed by bore holes is about 11 24 02 200 sq ft Taking the average thickness of the selenitic zone as 21 the total reserve of selenitic clay and marl in the area can be estimated at 2 36 04 46 700 cu ft As the concentration of selenite in the selenitic clay and marl zone is about 2 tons per 1 000 cu ft the reserves of selenite in this area will be about 47 20 900 tons Assuming that 20 per cent of the material has already been worked out or has been rendered unavailable the reserves of selenite available in the area can be estimated at 38 00 000 tons

The nature of the gypsum deposit near Ran as well as the reserves of gypsum in the area are now more or less fully known and the next problem is to work out a suitable method for working the deposits on a commercial scale Dredging hydraulic working or ground sluicing are perhaps the best possible methods of working this type of deposit The problem of water supply and line communication are important factors to be considered in this area The technical feasibility and the cost of working the deposit can only be judged by actual field work

The Electron Microscope at the National Physical Laboratory, India

THE ELECTRON MICROSCOPE WHICH HAS BEEN assembled in the National Physical Laboratory is the E M U model of the *Radio Corporation* of America It is capable of giving a maximum magnification of 30 000 diameters which can be optically magnified to 1 50 000 It is capable of giving a resolution of 30Å which can resolve particles of molecular dimensions

Unlike the older models it is a vertical column design which minimizes interference from earth s magnetic field and has arrangements for five exposures of varying focuses or varying intensities on the same plate

Its high voltage supply is purely radio frequency which is the most modern application of electronic feed back control system and keeps the accelerating voltage (50 kV) constant to about 1 00 000 volts thus ensuring freedom from chromatic aberration in the electron beam Another special feature is the high speed pumping device which reduces the pumping time to two minutes thus enabling the worker to take pictures at intervals of five minutes

Finally it has arrangements for taking stereo and transmission and reflection diffraction pictures of the same specimen on the same plate which is a great advantage in studying the particle size and structure of crystalline materials

REVIEWS

Photoelasticity—Principles and Methods, by H T Jessop & F C Harris (Cleaver Hume Press Ltd London W 1) 1949 pp viii + 184 Price 28*s*

THIS BOOK WRITTEN MAINLY FOR THE practical worker deals with the recently developed subject of photoelasticity from its basic principles It goes on to give a comprehensive survey of the rapid developments in technique in recent years with particular reference to the use of newly developed plastics and the frozen stress method for the investigation of three dimensional stresses

The first two chapters briefly outline the principles involved and the methods followed in the mathematical analysis of stresses in two dimensions The next two chapters are an introduction to the optical side of the subject and deal with the principles of geometrical optics wave motion interference and polarization Chapter V discusses the production of isoclinics and isochromatics as well as the use of circularly polarized light to eliminate isoclinics and the use of compensators to evaluate the fringe orders These five chapters are written *ab initio* and five appendices contain examples of more difficult mathematical analysis separated from them

The next chapter contains a clear account of the methods used in the reduction and interpretation of observations including the determination of the lines of principal stress and the isotropic points the calculation of the separate stresses at a point and the application of these results to the prototype Consideration of stresses in three dimensions is taken up in chapter VII which also deals with the frozen stress methods The limitations of the frozen stress method especially near points of stress concentration are discussed as well as its use with slices cut from the model in planes of symmetry

The next two chapters contain an excellent description of the experimental technique of photoelasticity based largely on the author s own practical experience which will probably save the serious worker much preliminary investigation Chapter VIII deals with the optical arrangements of the photoelastic bench and different types of straining frames Of particular interest is the pneumatic straining frame designed by C Mylonas The use of sheets of cellophane or C R 39 as a substitute for mica quarter wave plates is also discussed in some detail Chapter IX opens with a survey of photo elastic materials used in modern practice and a discussion of time creep and time edge effects The preparation of models and the techniques of annealing and loading as well as of frozen stress procedure are described

The last chapter rounds off the whole book with five practical examples which illustrate the methods of interpretation and reduction of observations outlined earlier

The whole book is written in a clear and vigorous style and the treatment is essentially practical An attractive feature is the number of excellent diagrams In view of the wide recognition of photoelasticity as a powerful tool in the investigation of stress problems this book will be found invaluable by engineers and designers as well as by technical students

P HARIHARAN

Electronics Experimental Techniques, (National Nuclear Energy Series Manhattan Project Technical Section) by W C Elmore & I Sands Matthew (Mc Graw Hill Book Co Inc New York Toronto London) 1st Edition pp 417 Price $ 3 75

ELECTRONICS IS PLAYING AN EVER INCREASingly important rôle in detection study and measurement of nuclear and other physical phenomena Electronic circuits are being used effectively for making nuclear and other physical measurements and for counting transient acts of active atomic nuclei From the time of the earliest developments of the science of electronics many ingenious methods for application have been devised and many electronic circuits for detection measurement and multifarious types of counting have been designed and constructed by many workers in the field The literature regarding the theory development and performance of these electronic circuits has been widespread But there have been only very meagre expositions of the theory design and construction of electronic circuits used for atomic, nuclear and other physical measurements and a great need for a thorough exposition of the subject has long been felt by workers in the field

The publication of the work under review fulfils this need It deals very ably with the fundamentals of electronic circuit components and circuit elements It explains the fundamentals and basic principles of electronic circuits which would prove useful in giving an excellent background for the design of new circuits The authors of this book, as members of the electronic group of the Los Almos Laboratory were responsible for the development of electronic instrumentation and electronic circuits of various types especially intended for nuclear and atomic energy research work They have made an extensive survey of all types of important and efficient electronic circuits available with various electronic groups who were working for the atomic energy development schemes Of these, the authors have selected the most useful and efficient types of circuits for description in the chapters of this book As such the work should prove extremely useful for those who are engaged in making nuclear and other physical measurements

The book contains seven chapters The first deals with circuit components and construction practice, the second with circuit elements the third with voltage amplifiers the fourth with electronic counters, the fifth with oscillographs and associated equipment, the sixth with test and calibration equipment and the last with power supply and control circuits

In the first chapter the authors deal, in general with the circuit components of every type and their individual characteristics They also explain with diagrams the outlay and mounting of various types of counter circuits as arranged in chassis and the necessary rack arrangements for final assemblage of the circuits The second chapter deals with all types of circuit elements their principles, arrangements, performance and individual characteristics This chapter no doubt is very useful for all those who want to devise new types of electronic circuits for different purposes The third chapter describes mainly the theory, design and characteristics of voltage amplifiers The fourth chapter describes very ably many types of electronic counters including single counters, co-incident counters, scalers and mechanical counter operating circuits The fifth chapter deals with the general principles of cathode ray tubes and describes some important circuits suitable for oscillographs This chapter also describes a number of time-marker generators such as pip generators, blanking generators, etc It further deals with trigger delay circuits and trace-brightening circuits The sixth chapter deals, in general with test and calibration equipment such as laboratory oscillographs general purpose sweep circuits, voltage pulse generators, pulse generators for accurate amplitude calibrations, trapezoidal voltage pulse generators and a number of other allied instruments with their respective characteristics and uses for different purposes The last chapter deals with the fundamental principles of power supply and control circuits and describes diagrammatically a number of them which would, no doubt be of immense value to all the workers in the field of electronic technology as applied to nuclear and other physical measurements

This volume should be a welcome work to students and workers in the field of nuclear and atomic power energy research It will be a very valuable addition to libraries and research laboratories engaged in nuclear and other physical measurements

SWAMI JNANANANDA

Experimental Physical Chemistry, by F Daniels, J H Mathews, J W Williams, P Bender, G W Murphy & R A Alberty 4th Edition, 1949, pp xiii + 568 Price $ 4 5

THIS BOOK, WHICH IS ALREADY VERY POPULAR in many universities, has been revised so as to increase its usefulness Apparatus has been re-designed and procedures have been simplified so as to reduce the incidence of equipment failure in crowded laboratory sections New commercial instruments such as the Beckmann and Coleman photoelectric spectrophotometers have been described Almost every chapter reflects the recent advances in the past decade The book has undoubtedly improved in its usefulness and is very suitable as a text-book of practical physical chemistry for university students, as well as a reference book for research workers

K S G D

Organic Chemistry, by G Bryant Bachmann (International Chemical Series, McGraw-Hill Book Co Inc), pp 432 Price $ 4.25

THIS TEXT-BOOK IS PRIMARILY INTENDED FOR students of organic chemistry at the degree class stage and not for those who have taken up an advanced course Still the book is sufficiently broad in scope and contains detailed information to serve as a reference book for advanced students

The author has adopted rules of the International Union of Chemistry from the outset and systematic naming of organic compounds is introduced early in the book. This has helped to avoid a lot of confusion to the beginning student The electronic concept of valence is made the basis for study of structures and properties not readily understandable in the light of other theories A simple and new method for the student to use in predicting the products of organic reactions and in selecting suitable starting materials for the synthesis of various types of compounds is a noteworthy feature of the book

The author has presented those applications and generalizations of the subject which form the basis for a study and understanding of organic chemistry in such a way that they are easily learnt and remembered. The book does not restrict itself to a limited survey of certain specific topics but supplies concisely a wealth of information on a large variety of subjects Up-to-date and brief accounts on electronic resonance in organic molecule, chemical constitution and colour, chemical constitution and physiological action and synthetic polymers are given Modern developments such as synthetic rubbers, paludrine, silicones and antibiotics are also dealt with In addition, a chapter on definitions, a list of reference books, both for elementary and for advanced study, and model exercises at the end of each chapter are included in the book.

The volume falls in line with the excellent text-books on organic chemistry now in use in various universities in India and may be read with benefit by students as well as by teachers

A.K.

Modern Methods for the Analysis of Aluminium Alloys, by G. H Osborn & W Stross (Chapman & Hall Ltd., 37 Essex Street, London, W.C 2), 1949, pp 144 Price 13*s* 6*d*. net.

THE BOOK UNDER REVIEW IS THE CONCERTED effort of the Committee of Chemists formed by a group of firms engaged in aluminium light alloy refining known as Alar. The book is confined to elements related directly to aluminium alloys and the methods described are those that have been thoroughly tested in the laboratories of the member firms The great demand for aluminium alloys accentuated by the war and the need for conforming to exact standards have necessitated the development of newer methods and the introduction of physico-chemical instruments, the polarograph and the photometer Some of the methods employed in the control laboratories are very different from those as yet published in the general text-books The publishers have done a distinct service by bringing out this book. Although the appeal is mainly to the practical analyst seeking the latest procedure for rapid and accurate analysis of the elements, sufficient theoretical explanations have been given wherever necessary The book is neatly printed and well bound. The reviewer feels that the price of 13*s*. 6*d*. is prohibitive for a book of 144 pages.

G GOPALA RAO

Aluminium and Aluminium Alloys Extruded Sections (DESIGN AND TOLERANCES) (The Aluminium Development Association, 33 Grosvenor Street, London, W 1), 1949, pp 45 Price 1*s*

THE INFORMATION BULLETIN PUBLISHED BY the Aluminium Development Association under the title *Aluminium and Aluminium Alloys Extruded Sections* is undoubtedly a valuable pamphlet for all those connected with the use of aluminium This bulletin gives a clear picture of the potentialities of aluminium and its alloys Two decades ago aluminium was widely used for making ordinary utensils and only a few parts made of it were used in machinery Now with the advent of newer types of aluminium alloys aluminium extrusions have found their way in many places where steel was normally used

For the manifold applications to which aluminium is put its remarkable behaviour under heat treatment has been the main factor for when the metal or its alloy is subjected to heat treatment the tensile strength increases to a considerable extent Being a light metal aluminium has a better strength-weight ratio compared to many other metals During the war aluminium extrusions were used mainly in aircraft and here they have proved very efficient under very severe conditions over a period of years Now there is practically not a branch of engineering where aluminium and its alloys are not used in some form or the other

In the bulletin there are 9 tables giving valuable information about mechanical properties tolerances available sizes etc of aluminium extrusions Out of the 26 figures given there the first 7 illustrate the process of extrusion and other details connected with it in Figs 8 to 26 are illustrated the various applications of aluminium extrusions in different branches of engineering and test data are given for each type of extrusion

Though there is nothing original in this pamphlet the reviewer feels that the vast amount of data collected should prove highly valuable to many small manufacturing industries using aluminium extrusions as the basic material in their products

V CADAMBE

An Introduction to the Theory and Design of Electric Wave Filters, by F Scowen (Chapman & Hall Ltd London) 2nd Edition 1950 pp xi + 188 Price 18s

THIS BOOK COVERS THE TECHNIQUE AND design of wave filters which are very essential for the telephone and wireless engineers Wave filters are widely used in many electronic circuits carrier-wave telephony and telegraphy A wave filter is an electrical network used for either passing through or rejecting a signal of a particular frequency or signal covering a small band of frequencies in the audio and radio frequency spectrum In any general electrical circuit where low and high frequency signals are being handled, the filter is an essential feature All telephone and telegraph transmitters depend very much upon the efficiency of the filter circuits used therein

Following a short mathematical introduction on simultaneous and quadratic equations and on hyperbolic circular and inverse functions which are the basic requirements for the design the author discusses the electrical networks and the evolution of filters from such network using inductance and capacitance as the components The simple characteristics of a filter are well explained and the equations for a particular line impedance and a cut off frequency are derived systematically from the fundamental principles using hyperbolic functions These equations are of immense value to the engineer who wishes to design and construct a filter M derived filter is the modified form of the simple one and the characteristics of it give a sharp pass or rejection to any signal of particular frequency Equations for a m derived type filter wherein infinite attenuation is achieved with resonance phenomena on either side of the required signal are also derived from the simple equations obtained for low pass high pass and band pass sections For various values of m the author has given types of curves that can be obtained For further simplification the various values to be used for a m-derived shunt and series types of band pass filters which are widely used are also given

In practice reflection and insertion loss are the two main factors that are to be considered when designing wave filters Impedance matching phase shift and attenuation factor are also important to get the filter characteristics These are discussed in detail by the author with reference to some practical problems After the design of a filter the engineer is faced with the problems of testing and technique of quantitative measurements when the filter is put into actual circuit These problems are also well discussed at the end

The book is a simple and well-written treatise on the theory and design of wave filters The design of any particular type of filter can be handled well with minimum of labour using the derived equations The presentation of the text is so systematic that it can be well recommended as a text-book Telecommunication engineers will find it a good companion volume to some of the earlier books on the subject by Campbell, Shea and Sterr

C S RANGAN

Paper Base Laminates, by S E Sorrell (Cleaver-Hume Press Ltd , London), pp 223 + 4 plates Price 12*s* 6*d* net

THIS LITTLE BOOK, WRITTEN IN CLEAR AND simple language, will serve as a very useful introductory study of the technology of paper base laminates, which have found such versatile and ingenious applications in different industries One cannot help feeling that a more valuable monograph could have been brought out by the author if he had not limited the scope of the book to paper base laminates alone but had included products such as plywood, glass-reinforced laminates, etc

After a too brief introductory chapter covering only 3 pages, the author proceeds to a fairly detailed consideration of the two essential components of paper base laminates, namely the paper base dealt with in chapter II and the resin binder dealt with in chapter III The resin treatment of paper, prior to the formation of laminates, is dealt with in chapter IV Chapters V, VI and VII deal with the different laminating procedures, special purpose laminates such as composite boards, wire-reinforced laminates paper tubes, etc , and special techniques in the fabrication of laminates In chapters VIII and IX the specifications, the methods of testing the mechanical and electrical characteristics of the laminates and the different factors influencing the physical properties of the laminates are described at length In chapter X a very brief review of the different applications of paper laminates is given

As the author himself has admitted in his preface to the book, the routine methods of paper-making have been dealt with in comparatively greater detail than the manufacture of the resins Despite the author's attempted justification of the same on the grounds that information on resin manufacture is readily available whereas, according to him, many readers are not so familiar with the processes of paper manufacture, the book leaves a feeling in the reader's mind that the author has a purposive partiality towards the paper-making industry. There will be nothing wrong in this if the author had concentrated more on the special aspects which are involved in the manufacture of specific types of paper particularly suited to, and useful for, making plastic laminates rather than on the usual routine methods of paper-making, which are normally dealt with in any ordinary book on paper manufacture A more detailed discussion of the ultimate properties of the resulting laminated products in terms of the physical and mechanical characteristics of the fibre the anisotropy, the orientation of the fibres in the paper structure, the absorbent nature of the paper, etc , would have been highly relevant in this connection

Chapters IV to VII, dealing with the treatment of the paper the laminating procedures and the special types of fabrication of laminates, are very well written and are undoubtedly of great use to one interested in the manufacture of laminated products In these chapters the author has collected almost all the latest techniques in use, which is difficult for an ordinary technician or a man of the trade to collect from the vast scientific literature on the subject The technique of deep-drawing of laminates, however, seems to have escaped the author's attention in the preparation of chapter VII A number of papers dealing with significant improvements in deep-drawing technique have been published both by workers in America and in India Chapters VIII and IX contain valuable information on the specifications and the methods of carrying out the tests for various mechanical and electrical properties and also the different factors which have a bearing on the ultimate physical properties of the laminates The last chapter dealing with the applications of paper base laminates is too brief and covers only 3 pages of the book This appears to be rather inadequate in view of the diversity of interesting applications referred to in recent literature This probably could not be helped for want of space

One or two mistakes of a minor nature have occurred in this book "Aniline resins" should not have been spelt as "*Analine* resins" as has been done in the book In the subject index it is indicated that pages 33 and 208 contain references to glass fibres. It has been noticed, however, that there is no reference whatsoever to glass fibres on page 208 This is perhaps an oversight in the final preparation of the manuscript and in any case is not of much consequence since the book is wholly devoted to the subject of paper base laminates and as such the reader need not expect to find much about glass fibre-reinforced laminates in the book

On the whole, the book is very well written. The exposition of the subject is clear and concise There is no doubt that the book will be of great usefulness to the junior classes of research workers It will serve as an incentive for a more detailed study by going to the original papers published in recent scientific periodicals to which very discriminating and valuable references are cited at the end of each chapter The price of the book is perhaps a little too high for its size.

A J R.

Modern Workshop Technology, by M Wright (Cleaver-Hume Press Ltd, London), 1950, viii + 514 Price 32s.

THIS BOOK FULFILS ADMIRABLY THE NEEDS of a practical man in the works, who requires a theoretical background for workshop technology in addition to the essential practical details pertaining to the working of his machines and tools

Each chapter has been written by one who is an authority on the subject and, therefore, full details are provided for how and why of everything that one has to handle in the workshop The book deals with problems of every type met with in the workshops and is recommended for those who have anything to do with the workshops either in a supervisory or an official capacity This volume gives an up-to-date and concise survey of British tools and provides an adequate outline of the principles of measurement and inspection The last chapter on "Human Relations in the Workshops" is of special interest to the supervisory staff and is, in the opinion of the reviewer, most valuable under the conditions obtaining at present in the country when proper handling of staff problems can go a long way towards increased production in the workshops.

D. R. MALHOTRA

Theory of Wing Sections, by Ira H. Abbott & Albert E von Doenhoff McGraw-Hill Book Co. Inc, New York), 1949, pp viii + 693. Price $ 15.00

AFTER WORLD WAR II, MANY BOOKS HAVE been published on aerodynamics, both in U S A and U K But there is hardly a book in which the aerodynamic theories that are most useful in working with the wing sections are brought together. In this book, the author and his colleague Albert E von Doenhoff have systematically developed the theory of "wing sections" from the classical hydro-dynamics, involving simple two-dimensional flows to the effects of compressibility at subcritical speeds The authors are well-known authorities in this field and are connected with the premier body, viz the National Advisory Committee for Aeronautics.

This book presents all the useful aerodynamic theories of wing sections, together with a comprehensive summary of experimental results Though the theoretical treatment progresses from elementary considerations, yet a sufficient knowledge of calculus, differential equations and complex variables is necessary for easy understanding of the text The mathematical calculations of NACA low-drag airfoils were so far not accessible to students for classroom study With the de-classifying of the confidential work done during the war, the authors have taken full advantage of the opportunity to treat exhaustively in this volume the theory behind these low-drag airfoils One noteworthy point about the book is that the use of "vectorial notations" has been scrupulously avoided in the mathematical treatment

The volume is rather unwieldy for use as a text-book in the under-graduate study, in the graduate course it can be used in the fifth and sixth years, but for practising engineers and research workers it should prove a valuable reference work.

There are 9 chapters in the book which bring together all the theories essential in working with the modern wing sections, particularly those of NACA types. A list of 160 useful references are included. The outstanding feature of the publication is comprehensive appendices on basic thickness forms, mean lines, airfoil ordinates and aerodynamic characteristics of wing sections.

The reviewer feels that the price of the book seems to be on the high side, although the vast amount of data presented may justify it

This book is the first of its kind to be published giving valuable and exhaustive information on wing sections for the practising engineer.

V CADAMBE

Communication Circuit Fundamentals, by Carl E Smith (McGraw-Hill Book Co Inc, New York), 1st Edition, 1949, pp 401 Price $ 5 00

THE WORK UNDER REVIEW, ENTITLED "Communication Circuit Fundamentals", is designed as a text-book for students of technical physics who are interested in specializing in the field of communication engineering It meets the needs of radio operators and technicians who wish to equip themselves with the fundamental knowledge of this branch of science so as to enable them to tackle the problems of repair and improvement in communication services

As a preliminary to a systematic treatment, after explaining the basic principles of the electron theory, the author deals with the fundamental electrical quantities which are essential for the formulation of the theory and deduction of quantitative expressions for circuit constants and alternating and direct-current circuits These electrical quantities are presented in a form best suited for a systematic study of the subject

The book ably deals with the physics of circuit elements and components together with the thermionic valves It explains the fundamentals of alternating and direct-current circuits The circuit constants are discussed in detail and are then used in a treatment of direct-current circuits The principles of alternating circuits are also treated after explaining the relevant principles of magnetism, inductance and capacitance. Ohms and Krichhoffs's laws are explained and are used in solving simple problems of direct-current circuits The alternating-current circuits are treated with the application of vector notation A comprehensive treatment of the theories of some of the important networks is given so as to enable the students to apply them for various problems

Each chapter of the book gives the theory, develops design equations and scrutinizes them in a manner so as to enable the students to understand and solve many important problems The book, therefore, will be found very useful not only to the students of technical physics but also to the electrical and communication engineers It will also be useful as a reference book in research laboratories

SWAMI JNANANANDA

PUBLICATIONS RECEIVED

THE ROLLING OF METALS (Vol I), by L R Underwood, Chapman & Hall, 42*s*

PRACTICAL APPLICATIONS OF SPECTRUM ANALYSIS, by Herbert Dingle, Chapman & Hall, 40*s*

THE PROPERTIES OF METALLIC MATERIALS OF LOW TEMPERATURE, Vol I, by P Litherland Teed, Chapman & Hall, 21*s*

VEGETABLE CROPS (4th Edition), by Homer C Thompson, McGraw-Hill, $ 6 00

THE ORGANIZATION OF INDUSTRIAL SCIENTIFIC RESEARCH (2nd Edition), by C E. Kenneth Mees & John A Leermakers, McGraw-Hill, $ 5 00

ESSENTIALS OF ELECTRICITY FOR RADIO AND TELEVISION, by Morris Slurzburg & William Osterheld, McGraw-Hill, $ 4 00

THRESHOLD SIGNALS, by James L Lawson & George E Uhlenbeck, McGraw-Hill

PRINCIPALS OF AERODYNAMICS, by James H Dwinnell, McGraw-Hill, $ 5 50

NOTES & NEWS

Q-Enzyme

HAWORTH *et al* ISOLATED AN enzyme, termed *Q*-enzyme, in potato juice, capable of converting amylose to amylopectin The enzyme is obtained in a pure crystalline form by precipitating it, at low temperature, with ethanol from solutions of low ionic strength followed by crystallization from ammonium sulphate solution (*Nature*, 1950, 165, 573)

Peeled and sliced potatoes are steeped in 0·7 per cent sodium hydrosulphate solution for 20 min, washed in water, minced and the juice expressed is centrifuged and brought to a concentration of 11 per cent in ethanol at −2°C The precipitate is discarded and the ethanol concentration raised to 16 per cent at −5°C to give a further precipitate This is taken up in sodium citrate solution (*p*H 6·0) and ionic strength 0·01 and the solution again brought to 11 per cent in ethanol The slight precipitate is removed and the concentration of ethanol again raised to 16 per cent, the *p*H and ionic strength being kept constant throughout The precipitate is taken up in citrate solution and reprecipitated at 16 per cent ethanol The final precipitate is dissolved in citrate solution and ammonium sulphate added (at 0°C) to an ionic strength of 3 8 and *p*H of 6 2 The precipitate is dissolved in water and ammonium sulphate is added at 10°C until a cloudiness appears at an ionic strength of about 3 2 The solution is cleared by adding a minimum amount of water and then cooled slowly to 0°C *Q*-enzyme separates in a few hours in needle-like crystals.

A solution of amylose of initial light absorption value of 1 30 was half-converted into amylopectin in 12 min at 20°C in 0·2*M* sodium citrate solution of *p*H 7·0 in a digest containing 2 2 × 10^{-3} mg of enzyme per c c

Vitamin B_{12}

THE ISOLATION AND PROPERTIES of vitamin B_{12}, the active principle of liver, are described (*Chem Age*, 1950, 62, 575)

Vitamin B_{12} has been isolated by exclusively physical means from liver owing to the absence of any particular chemical properties characterizing it. The methods include adsorption (charcoal or alumina) and partition chromatography (using damp silica and butanol) In the latter method three zones were obtained brown at the top, pink in the middle and yellow at the bottom All the activity was found to be concentrated in the pink fraction Deep-red crystals of the pure vitamin were obtained from aqueous acetone after repeated purification by chromatography and subsequent concentration One ton of liver was required to give 15 mg of the pure vitamin

Vitamin B_{12} exhibits a typical and characteristic absorption spectrum of its own X-ray crystallography has confirmed its molecular weight of 1650·100 for the hydrated substance The chemical formula is given as $C_{61\text{-}64}H_{86\text{-}92}N_{14}O_{13}PCo$ Its synthesis by *Streptomyces griseus* has been achieved on a commercial scale The substance could be synthesized by certain intestinal bacteria

Further work has resulted in the isolation by chromatographic means of another red factor vitamin $B_{12}b$, also clinically active

Vitamin B_{12} has a phenomenal potency producing haemopoietic response in pernicious anaemia in doses of about 0·001 mg, folic acid of 5,000-10,000 times this amount is needed for the same response The vitamin contains about 4 per cent of cobalt, thus being the first time that the metal has been found in a pure material of biological origin

Colour Reaction for Pyrethrins

THE REACTION PRODUCT OF CARboxylic acid derivatives and hydroxylamine forms coloured complexes with ferric chloride Similar complexes are also formed with pyrethrins and their synthetic analogues (*Nature*, 1950, 165, 567)

6 c c of alkaline hydroxylamine reagent (3 c c 2*M* hydroxylamine hydrochloride solution and 3 c c. 3 5 *N* sodium hydroxide solution) was added to 3 c c of an ethanolic solution of ester and the mixture allowed to stand for 1 min or more, acidified with 3 c c of hydrochloric acid (1 vol conc acid, sp gr 1 18+2 vol water), and finally 3 c c of ferric chloride solution (0·37 *M* in 0 1 *N* hydrochloric acid) was added. A blank was carried out with ethanol alone and absorption measurements were made The absorption spectra of the complexes obtained from a mixture of the natural pyrethrins, purified by the nitromethane technique, and the synthetic pyrethrin analogue, the *DL-cis-trans* chrysanthemum monocarboxylic acid ester of 3-methyl-2-allyl-*cyclo*-penten-4-ol-1-one are similar to these The absorption by the coloured complexes at λ 540 mμ is proportional to the amount of ester used, the reaction is also dependent upon the acidic and alcoholic components of the ester Thus, to give the same colour intensity, the amount of synthetic pyrethrin analogue required is 3 3 times that of the natural pyrethrin mixture (pyrethrin I pyrethrin II = 1 6 1) Since the naturally occurring esters of chrysanthemum dicarboxylic acid (pyrethrin II) contain two ester groupings, they may be expected to yield a more intense colouration than the esters of chrysanthemum monocarboxylic acid (pyrethrin I) which is in line with the experimental results.

The reaction which should prove useful for the detection of pyrethrins in chromatographic separation cannot, however, be applied to the estimation of pyrethrins unless (1) they can be first separated, or (2) the ratio in which pyrethrins occur is known to be constant

Measurement of Proteolytic Activity

A NEW METHOD IS DESCRIBED FOR determining the activity of proteolytic enzymes by detecting the change effected in the affinity of the native albumin for simple dye anions in the presence of such enzymes. Quantitative activity measurements may be made by estimating the concentration of the native protein in the presence of the proteolytic enzyme as a function of time, using an empirical curve as is usually done in spectrophotometric analysis. In this method the quantity of native protein remaining in solution is measured, whereas the usual determination is based on an analysis of the products of hydrolysis (*Science*, 1950, 111, 387)

The effect of a 0 1 per cent pepsin solution upon a 0 2 per cent albumin solution at *p*H 5 4 in the presence of a constant concentration of the dye, Orange I, has been studied The addition of bovine albumin to the dye causes a depression of about 20 per cent in the absorption maximum and on adding crystalline pepsin, the optical density of the reaction mixture in the presence of the dye approaches that obtained for the dye alone

The reason for having the concentration of pepsin as high as 0 1 per cent and the *p*H at 5 4 instead of 2 was to gather information on the nature of enzyme substrate interaction Nevertheless the method is generally the same if conditions of *p*H and initial concentration of enzyme and substrate are altered Using the procedure outlined above, no particular difficulty was encountered in studying the activity of pepsin on albumin at *p*H 2 when enzyme concentration was one part per billion

An important difference in the activity when determined by the dye method instead of classical methods, is that the linear effect of enzyme concentration on the reaction rate can be observed not only at the beginning of the experiment, but even when 50 per cent or more of the native protein has been removed

The use of dyes as indicators for following the course of a proteolytic reaction may offer the advantages of increased sensitivity and ease of adaptation of the method to micro-procedures

Manganese Dioxides

SOME MANGANESE ORES ARE FAR superior in dry cell manufacture while others excel in certain chemical processes The reasons for these differences in their properties have been investigated (*C T J*, 1950, 126, 935)

The ores examined were African, Belgian Congo, Montana and Caucasian The method of differential thermal analysis depends on the fact that minerals show breaks in their heating curves at points where changes in composition or physical structure take place By comparing the temperature of a substance heated at a definite rate with that of a thermally inert substance such as alumina heated under the same conditions, a differential temperature curve is obtained which is characteristic of the material examined The temperature at which such transformations occur serves to identify the mineral involved while the magnitude of the transition break indicates the quantity present Ergogene and Montana ores give small peaks while the relatively inactive Caucasian ores give a high double peak These observations are in line with the known relative activities exhibited by the ores Tests conducted to explain these observations indicate that the product of decomposition of Caucasian manganese dioxide is first α-manganese oxide which is transformed by continued heating or higher temperature to bixbyite and hausmannite X ray diffraction and chemical analysis have indicated the existence of a whole series of compounds between the end members ramsdellite (γ-manganese dioxide) and pyrolusite (β manganese dioxide) Many ores contain manganese dioxides in such a complex mixture that the relative strengths of the different component patterns are difficult to determine African Gold Coast mineral can be considered as the poorly crystallized and impure ramsdellite Pure anhydrous manganese dioxide has been demonstrated in only two forms namely ramsdellite and pyrolusite which occur naturally and are limited to well-crystallized materials giving sharp X-ray patterns

From the battery manufacture standpoint the compositions of the African Gold Coast ores is important The principal components of the ore have been identified to be poorly crystallized ramsdellite The Montana ores are more impure and complex than the African ores The major component is γ manganese dioxide with quartz cryptomelane lithiophorite and pyrolusite as the main impurities Caucasian ore is composed almost entirely of pyrolusite with more or less manganite and a trace of quartz Ergogene and Burgess chemical ore are typical of a group of artificial chemical ores and contain as the major component γ manganese dioxide with cryptanelane quartz and bixbyite as principal impurities An electrolytic product is composed of γ-manganese dioxide and contains a little graphite from the electrodes employed

Vulcanization of Rubber

A NEW PROCESS FOR THE VULCANization of rubber makes use of mild oxidizing agents in place of sulphur (to a substantial extent) normally employed and also eliminates the use of zinc oxides (*Industr & Engng Chem* , 1950 42, 671)

Conventional vulcanization may be considered a two-step oxidation process in which zinc oxide or zinc soap functions through its ability to form zinc mercaptides which are more easily oxidized by sulphur to disulphide cross links than are thiol compounds As zinc oxide or zinc soap is required in the second step of the sulphur reaction the use of a suitable oxidizing agent eliminates the necessity of these materials

2, 2′ dibenzothiazyl disulphide examined for this purpose readily oxidizes hydrogen sulphide to free sulphur and reacts relatively slowly with rubber Vulcanization was carried out at 110°C for a period selected to give the maximum physical cure as measured by stress at 200 per cent elongation The replacement of zinc oxide and stearic acid by 2, 2′-dibenzothiazyl disulphide increased physical cure and in air absence of sulphur but the compound itself is not a vulcanizing agent The compound was most effective in replacing zinc oxide when it is accelerated with a metal (zinc) salt of a dithiocarbamic acid and brings about the greatest physical cure At equivalent molecular concentrations methazate and butazate (zinc salts of dimethyl and dibutyldithiocarbamic acid) are equally effective About 0 0035 mole is required to give maximum physical cure in a compound containing 0 02 gm atoms of sulphur (0 64 part) and 10 parts of 2, 2′-dibenzothiazyl disulphide Other milder oxidizing agents which proved effective include quinine dioxime diazoaminobenzene, *bis*-(ethoxyphenyliminomethyl) - disulphide, N-nitrosodiphenylamine, quinone *bis*phenylimine, 2 2′-dibenzothiazyl disulphide and benzothiazyl - 2 - monocyclohexyl sulphonamide None of the chemicals, effective in the new process, brings about any cure in the absence of sulphur However, rubber containing hydrosulphide groups can be vulcanized by thiazyl disulphides alone

Recent Applications of Thallium

THE COMPARATIVE SCARCITY OF thallium, the limited knowledge of its properties and the high cost of extracting it from known sources have hindered its commercial development On account of the increasing importance of the element, in recent years, its properties have been studied in detail by the *U S Bureau of Mines* (*Chem Age*, 1950, 62, 685)

The natural sources of thallium comprise deposits of thallium minerals, rocks containing small proportions of such minerals and water or brine with traces of dissolved thallium compounds No ores of the element that can be commercially exploited exist The sources are industrial wastes and residues derived from metallurgical and chemical processes in which thallium from the original raw material has been somewhat concentrated

A recent application of thallium is in the manufacture of incandescent lamps Thallous salts, being more stable than thallic compounds, absorb traces of oxygen in such lamps and hence prolong the life of the tungsten filament

Several new uses of thallium have been developed within the past decade Even at the present high prices thallium and its compounds can be employed to advantage for a number of commercial as well as scientific and military applications

Alloyed with silver or lead, thallium greatly increases the corrosion resistance of the metals In conjunction with other metals, thallium forms alloys that have unique and valuable properties Examples are lead-thallium, silver-thallium and many ternary alloys By far the largest proportion is consumed in compounds for lenses and photoelectric cells in the glass industry to impart dark, opaque, black or brown colours as well as to increase density and provide an index of refraction higher than that of lead glass

Acrylic Resin Emulsions

ACRYLIC RESIN EMULSIONS OF the non-ionic type are becoming increasingly popular for formulation of grease-proof coatings and as binders for clays and in decorative colour coatings which must have good resistance to discolouration during ageing Some desirable characteristics and properties of these products are described (*Chem Age*, 1950, 62, 569)

Acrylic resin emulsions, suitable in the formulation of paper coatings, must have a 40 per cent solids content, sp gr 1 08 (25°C) and should be unaffected by acids, bases, salts and organic solvents They must possess high mechanical stability with thickness, such as concentrated water-soluble polymers, e g sodium carboxy methylcellulose They should be capable of being plasticized with other resinous compounds to increase the flexibility of the film, without affecting its ageing properties Common additions include acrylic resin dispersions, nitrile rubber latex, natural rubber and synthetic (neoprene and GR-S) lattices The emulsion should be without effect and indifferent to common pigments such as chrome yellow, iron oxide, cadmium red, ultramarine blue, titanium oxide, carbon black, chrome oxide and organic red A number of variables such as the degree of porosity of paper stock, maintenance of a proper balance of coating, viscosity and solids and proper control of bubble formation (by adding compounds like caprylalcohol) give successful coating

It is possible to obtain continuous, completely grease-proof coatings on 60 lb patent board in one pass at coating weights as low as 1 9 to 2 4 lb /1000 sq ft Where a partial proofing against grease is desired, good results have been obtained at 0 9 lb /1000 sq ft , where the base stock is less porous, deposition of continuous grease-proof films is possible in one pass at weights of 1 5 lb /1000 sq ft When used as a binder for high or low grade clays in pigmented coating compositions for paper, acrylic resin emulsions improve the handling characteristics and stability of the coating dispersion The emulsions may be modified with starch to improve flexibility and calendering and with casein to contribute superior resistance of the film to yellowing during exposure to ultra-violet light

Travelling Wave Linear Accelerator

A NEW MACHINE (FIG 1), WHICH can generate energies of 3 5 million electron volts and accelerate electrically charged atomic particles almost to the speed of light, has recently been set up at Britain s Atomic Energy Research Establishment at Harwell The machine also serves as a means of providing a plentiful supply of neutrons

A powerful radio transmitter, working at a wavelength of 10 cm , provides electrical waves which speed up the movement of electrons Short high power bursts (each lasting two millionths of a second) emitted by the machine further accelerate

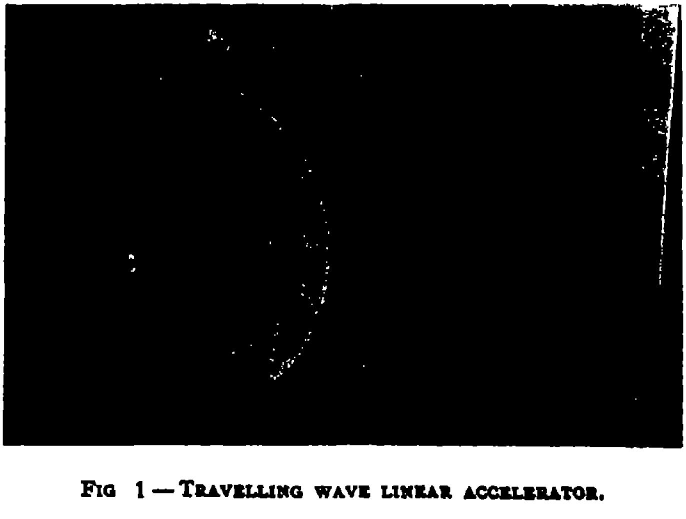

FIG 1 — TRAVELLING WAVE LINEAR ACCELERATOR.

these electrons which are directed at a heavy metal target which, in turn, emits "hard" X-rays or γ-rays These γ-rays enter a tank of heavy water and the heavy hydrogen nuclei in the water break up and emit the neutrons When the machine is used at its highest capacity, in short bursts (each of which lasts only two millionths of a second), the number of neutrons released is at the rate of one million million per second Because there is a pause between each burst of energy, the actual number of neutrons released is about 1,000 millions per second

The new accelerator will aid the study of the effect of neutrons on nuclei of various elements which is of vital importance in the development of atomic energy for industrial purposes

Larvicidal Action of DDT

TRIALS WITH DDT, IN POWDER and emulsion form for the control of mosquito breeding in paddy fields where cultivation is done on the common inundation irrigation methods have been carried out by the Malaria Research Institute (*Indian J Malariol*, 1950, **3**, 165) The larva studied were *A subpictus*, *A annularis* and *C fatigans* DDT powder and Paris green diluted with soapstone were applied by hand, and DDT-toluene-terpentine emulsion diluted with water was sprayed The approximate dosage of the insecticide applied per acre was 2 gallons of DDT emulsion in water or 24 oz of DDT powder in soapstone or 6 oz of Paris green with soapstone The number of dips for larval collection (in ladles) was restricted to 15 for each plot

Test results showed that in the plots under DDT emulsion of strengths 2 5 and 1 5 per cent, breeding was lower than in the other plots No damage of any kind either in quality or quantity to the crop was reported from any plot under experiment

Carbon 14

THE RADIOACTIVE ISOTOPE, CARBON 14, has been successfully prepared at Britain's Atomic Energy Research Establishment.

Carbon 14 is prepared by inserting an aluminium cylinder packed with a nitrogen compound in the atomic pile Under the action of the bombarding neutrons, nitrogen is very slowly converted into Carbon 14 One year's exposure in the large pile at the Establishment converted only two nitrogen atoms in every million into Carbon 14 The isotope is eventually made available to research workers as radioactive carbon dioxide

A special container which fits into the wing tip of aircraft has been designed for transporting radioactive materials by air The container enables isotopes to be carried without the need for heavy lead sheeting A single parcel can be reduced from 30 lb to a few ounces, thereby effecting a corresponding decrease in transport costs

Atomic Sieve

THE BRITISH ATOMIC ENERGY Research Establishment at Harwell has recently been equipped with an electromagnetic isotope separation plant which is capable of separating atoms of heavy elements such as uranium and dividing them according to variations in weight

The process of separation is initiated by projecting a stream of electrically charged atoms into a magnetic field This causes them to travel in a circle, during which the centrifugal action throws the heavy atoms on to the outer circumference from which they can be collected separately from the others The new separator can supply as much as 1,000 mg of separated atoms as against only one mg supplied by the small unit in use for the last two years

Thyroxine & Milk Yields

THYROXINE, WHEN ADMINISTERED to milch cows, has been found to increase their milk yield to a significant extent This method is being practised, to a limited extent, in some states in U S A

The use of synthetic *l*-thyroxine is recommended as it does not suffer from the disadvantages of the iodo-protein which causes undesirable effects in the animals and which is difficult to standardize

The average increase in yield obtained was 5 5 lb per day or 22 per cent of the initial yield of 25 lb per day Age of cow, productive capacity and stage of lactation are important factors affecting the amount of response Heifers show little effect and young cows less than old cows High-yielding cows show good response The best time to start the treatment would be for 8-12 weeks in late lactation Prolonged treatment results in reduced yields

The above considerations apply to moderate doses (100 mg per day) of thyroxine Dosages at higher levels produce harmful effects

Blood Meal Adhesives

IN VIEW OF THE HIGH PRICE AND shortage of casein and other raw materials used for adhesives, utilization of whole blood meal for the production of plywood adhesives has been investigated at the Forest Research Institute, Dehra Dun (*Indian Forest Leaflet*, No 108)

Whole blood from slaughterhouse to which either 3 per cent sodium fluoride or 1 per cent sodium oxalate has been added as a preservative was used On drying in shallow trays in a kiln at 60°C and 60 per cent relative humidity, 600 lb of blood yielded 12 lb of blood meal moisture, 16 79 per cent, fat, 0 87 per cent, ash, 8 9 per cent and nitrogen, 11 44 per cent This blood meal, powdered and soaked in water for about 30 min, was used in conjunction with ingredients such as lime, borax and ammonia for making plywood boards (with $\frac{1}{16}$" rotary cut veneers of *Cedrela toona*) The plywood specimens conformed to the specifications of commercial plywood (grade I) Tests on the susceptibility of the glue to microbial attack on the adhesive show that addition of 5 to 10 per cent "Santobrite" preserves the glue and its adhesive power is satisfactory However, it is best to use the glue immediately after it is made The dried blood meal can be stored up to 4 weeks without any appreciable deterioration in its quality

Some typical formulae for satisfactory glue composition are given below The ingredients are added in the order in which they are mentioned

1	Blood meal	100	parts
	Water	175	,,
	Lime	3	,,
	Water	25	,,
2	Blood meal	100	,,
	Water	450	,,
	Lime	6	,,
	Water	50	,,
	Casein	100	,,
	Water	300	,,

	Lime	10	Parts
	Water	100	,,
3	Blood meal	100	,,
	Water	250	,,
	Lime	6	,,
	Water	30	,,
	Casein	100	,,
	Water	250	,,
	Lime	10	,,
	Water	50	,,
4	Blood meal	100	,,
	Water	175	,,
	Borax	7 5	,,
	Water	25	,,
	Lime	3	,,
	Water	10	,,
5	Same as 4 but with 15 parts borax		

A glue adhesion strehgth of 287 lb /sq in in dry tests and 197 lb /sq in in hot wet tests were observed in the case of formula 4

Strain Gauges

FOR THE IDEAL CONSTRUCTION OF a bridge, a crane, an aeroplane or a propeller shaft, etc , the engineer must know not only the properties of the material to be used but also the distribution of the strains and stresses occurring under different conditions of load The usual methods of measuring such stresses by mechanical and optical " extensometers " fail to answer the purpose, where the measuring points in a construction are difficult to reach Neither are they suitable when, as is the case at practically all points of an aeroplane, strong vibrations occur in addition to the usual static load In such cases strain gauges offer the solution

In essence a strain gauge is just a wire which, under a tensile force or a compressive force, undergoes an elongation and a consequent change in its electrical resistance and conductivity This change can be easily and accurately measured The wire used for the *Philips* strain gauges (FIG 1) is made of constantan (an alloy of 55 per cent copper and 45 per cent nickel) which is glued in a zigzag fashion on to a strip of paper The paper and the glue have to be so stiff as to ensure that the distortions taking place in the work-piece on to which the gauge is glued are fully transmitted to the resistance wire

Of the two types produced by *Philips*, the larger gauges are 5 5 cm long and about 1 cm wide, while the smaller ones are 3 cm long The gauge is covered with a thin layer of wax or with a sheet of rubber having inside it some moisture-absorbing material (e g silica gel), thus shutting out all air and moisture

Changes in the resistance of the conductor due to variations in temperature are negligible as the wire is of constantan A dummy gauge is applied close to the active one at a point where it is not subject to mechanical load The two gauges undergo exactly the same variations in temperature so that the changes in resistance are equal in both and cancel out in the bridge circuit, and only the resistance variation due to the load upon the work-piece is measured

The calibrating factor of the strain gauges, which is indicated for each individual gauge, enables the engineer to deduce the difference in stress in the work-piece from the variation measured in the resistance

The *Philips* strain gauge has been successfully employed to measure the stresses on the standards carrying overhead power lines of electric railways when one of the conductors suddenly breaks Another application is to measure the strains and stresses arising in the hull of a ship as it is launched into water The distribution of strain can be deduced from the changes in resistance taking place in a set of three gauges glued on to the hull close together at an angle of 120°

The strain gauges can also be used for measuring pressure and force, Pressure transmitted to a diaphragm on to which a strain gauge has been glued, causes the diaphragm to bend, and this brings about a change in the resistance of the strain gauge In this way, by using special pressure boxes, the weight of an aeroplane can be very quickly determined, without such means as a very large weighbridge They can also be employed for safeguarding costly constructions as, for instance, a crane, against overloading When the maximum permissible load is reached, the strain gauge applied at critical points sets an alarm going or switches off the power supply

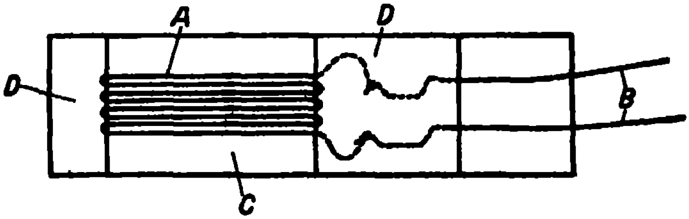

FIG 1 — A DIAGRAMMATIC SKETCH OF A STRAIN GAUGE.

The examples given above are only a few of a very wide variety of applications to which the instrument can be put Special strain gauges are being used for measuring and recording the beat of the heart and respiration by means of oscillographs.

Whale Liver Extract

WHALE LIVER EXTRACTS HAVE been found to be as potent as the extracts from bovine liver Oral administration of the simple aqueous whale liver extract filtered and concentrated (1 oz of extract = 25 oz of whole liver) to cases suffering from Addisonian pernicious anaemia resulted in good response It is possible that whale liver can be used off in the preparation of pharmaceutical liver extracts (*Indian J Pharm* , 1950, **12**, 108)

New Cotton Cleaner

A NEW MACHINE FOR REMOVING dirt and other foreign matter from raw cotton has been developed at the Battele Memorial Institute, Ohio, U S A

The machine consists of two concentric cylinders and the cotton to be cleaned is passed through the interspace Air from a number of small pressure jets entering through the outside cylinder blows away foreign matter from the cotton The process is repeated a number of times and the dislodged dirt is then skimmed off through special openings (*USIS*).

Fungi of Bengal

SEVEN HUNDRED AND SEVENTY species of fungi distributed over 240 genera are listed in a booklet (T C. Roy, Botanical Society of

Bengal, Calcutta, 1949, pp 44, price Rs 3) recently brought out by the Department of Agriculture, Government of Bengal This comprehensive list was compiled prior to the partition of Bengal and is the first of its kind to be published bringing together, in systematic manner, all the reported species of fungi The booklet contains 2 indices, one relating to host plants and the other to the genera of fungi

The booklet is a valuable adjunct to the scanty literature on the fungal flora of India and should be very useful to mycologists in devising plant protection measures and to research workers.

Indian Standards

Lubricants — A draft Indian Standard giving sampling and testing methods for lubricants has been brought out as a complement to the two recently issued draft standards relating to lubricants for various types of machinery The standard describes the procedures for a number of routine determinations The specialized apparatus used in the various methods is illustrated

Textile Machinery — Eleven draft standards on methods for the determination of various properties of textiles and two draft standards defining cotton and wool terms have been released The apparatus, procedures and evaluation of test results are also described

Aluminium Alloy Ingots and Castings — The first in the series of specifications on aluminium base constructional material for aircraft purposes has been issued by the Engineering Division Council of the ISI and relates to aluminium alloy ingots and castings The tentative standard has been drawn up after taking into account the resources available and technological practices obtaining in the country The standard is priced Rs 1/4 and may be had from the Secretary (Administration), Indian Standards Institution, 19 University Road, Delhi 8

Soaps — The draft is a supplement to the standards for soaps already issued by the ISI and lays down a standard method of sampling and test methods for the evaluation of important characteristics of soaps Critical reviews and comments on the draft will be received by the Director, ISI, up to September 1, 1950

Conservation of Industrial Coal

IN ORDER TO CONSERVE COAL resources in the country and to control coal distribution and production in industries, steps are being taken by the Indian Coal Commission to assess coal demands of different industries Requirements have been classified under the following heads

Coal for boilers , and coal and coke for industrial furnaces Boiler coals are again subdivided into (1) industry's boilers, (2) industrial power stations, (3) boilers in thermal power stations A systematic study of the behaviour of different classes and sizes of coal with existing equipment is being made in the Research Department of the Ministry of Industry and Supply to improve the range of steaming capacity and the range of fuel in power plants Suitable specifications for coals (percentage of ash, volatiles, fixed carbon to volatile ratio, etc) are being drawn up to meet the maximum continuous rating and peak load of power-station boilers and temperature requirements of industrial furnaces Coal requirements are also being correlated with production, the basis being power requirements per unit of production

Microfilm Service

THE INDIAN COUNCIL OF MEDICAL Research have set up a second Microfilm Service Unit at the Tata Memorial Hospital, Bombay, in addition to the unit at the Central Research Institute, Kasauli The new unit also will supply microfilmed copies of articles from any scientific journal available in Indian libraries

In order to make available the services of these microfilm service units, not only to scientific institutions and organizations, but also to individual research workers, the *I C M R* has decided to discontinue the practice of enrolling members to the scheme on payment of an annual subscription The charges for microfilming work are now made at the following flat rates Rs 3 for the first 10 pages or any portion thereof , Rs 1/8 for every subsequent 10 pages or portion thereof plus packing and postage

An equipment called " Reader " required to read the microfilmed articles can be obtained from *Messrs Kodak Ltd* , Kodak House, Hornby Road, Bombay

All requests for microfilming work should be addressed to the Officer-in-Charge, I C M R Microfilm Service Unit, Central Research Institute, Kasauli or to Dr V R Khanolkar, Director of Laboratories and Research, Tata Memorial Hospital, Parel, Bombay 12

Central Board of Forestry

THE GOVERNMENT OF INDIA HAVE constituted a Central Board of Forestry with the following functions (1) Co-ordination and integration of forest policy pursued by States in the management of their forests , (2) adoption of conservation measures affecting forest resources and soil , (3) integration of plans for land use and national reconstruction , (4) promotion of legislation for management of private forests in various states , (5) regulation and development of forests in inter-state river valleys, controlled by the Central Government, (6) maintenance of adequate standards of training of officers and (7) co-ordination of forest research conducted in Central and State institutes

Pan-Indian Ocean Science Congress, 1951

INVITATIONS TO ATTEND THE forthcoming Pan-Indian Ocean Science Congress to be held in India during the first week of January 1951 have been extended by the Government of India and the Indian Science Congress Association to Governments of various countries around the Indian Ocean The Congress will be held side by side with the 1951 Annual Session of the Indian Science Congress Association at Calcutta and is being arranged by the Indian Science Congress Association through the Department of Scientific Research, Government of India, who will make the necessary arrangements for the delegates attending the Congress.

The following countries, which are likely to be interested in the Congress, are being invited Australia, Indonesia, New Zealand, Iran, Kenya, Afghanistan, Tanganyika, Malaya, Uganda, Pakistan, Burma, Thailand and Ceylon

The objects of the Congress are to discuss and promote concerted action in regard to scientific problems specially affecting industrial progress, commercial interests, health, etc , and to strengthen the bonds of peace among all the peoples around the Indian Ocean by promoting a feeling of brotherhood among scientists and the maintenance of harmonious relations between them The Congress will have 10 sections and the topics suggested as a basis for discussion under each head are *Agriculture* (1) Plant Breeding, with particular reference to the production of improved varieties of wheat, (2) Soil Erosion and Soil Conservation Practices, (3) Tropical Agricultural Problems and the Use of Irrigation Waters Under Tropical Conditions *Botany* (1) Water Economy of Plants, (2) Plant Geography, (3) Classification of Plants *Chemistry* (1) Phytochemistry, (2) Forest Products *Economics* (1) International Trade of the Indian Ocean Area—Needs and Possibilities, (2) Comparative Consumption Standards of Populations Policies and Measures Favourable to Removal of Disparities, (3) Factors Determining Productivity and Comparative Costs of Major Industries *Geography & Oceanography* (1) Nature of the Floor of the Indian Ocean, Recent Changes of Sea Level and Water Circulation in the Eastern Indian Ocean, (2) Climatology with reference to the Influence of the Asiatic Monsoon on Non-monsoonal Climates, (3) Over-Population and Migration Problems *Geology* (1) Origin of the Indian Ocean, (2) Pre-Cambrian Countries, (3) Economic Problems *Physical Science* (1) Geophysical Investigations, (2) Cosmic Rays and Solar Radiations, (3) Weather Forecasting, etc *Public Health & Nutrition* (1) Infectious and Quarantinable Diseases, (2) Dietary Deficiencies. *Social Sciences* (1) Educational Standard, (2) Anthropology, Cultural Interchanges *Zoology* (1) Comparative Physiology, (2) Entomology and Parasitology, (3) Marine Biology, (4) Genetics

Announcements

The First International Conference on Atomic Energy, organized by the British Atomic Energy Research Establishment, is being held in September 1950 at the Oxford University The Conference will last for one week

Lord Reay Maharashtra Industrial Museum, Poona — In connection with the celebrations of the birthday of J N Tata, an exhibition, " the Schoolboy and His Tools or the Manual Training Workshop", commencing March 3, 1951, is being organized at Poona by Lord Reay Maharashtra Industrial Museum The exhibition is confined to small appliances and hand tools pertaining to all trades and will remain open for about six months Further particulars are available from the Curator of the Museum

The Andhra University has received a non-recurring grant of Rs 3 lakhs from the Government of India for instituting a course in Geophysics (M Sc standard) and for conducting research in the subject Another non-recurring grant of Rs. 2 lakhs has been sanctioned for implementing the expansion plans relating to the Departments of Chemistry, Physics and Geology

Indian Naval College — A site measuring 138 acres has been acquired by the Government of India in the Lawsons Bay area of Vishakapatnam at a cost of Rs. 27 lakhs for the establishment of the Indian Naval College

National Institute of Sciences of India Scholarships — The Council of the National Institute of Sciences of India made the following awards at its meeting held in May 1950 *Senior Research Fellowships* S P Basu (Calcutta), Sukh Dev (Punjab) and P B Mathur (Banaras) *Junior Research Fellowships* V Chandrasekharan (Mysore), A K Choudhuri (Calcutta), G S Deshmukh (Banaras), B D Mundkur (Bombay), N Sitapati (Andhra University), G Venkatachalam (Mysore) and (Mrs) Vidyavati (Lucknow) *Imperial Chemical Industries (India) Research Fellowships* C Balakrishnan (Madras), I M Chak (Bombay), A G K Menon (Madras) and G C Mitra (Calcutta)

ERRATA

This Journal, 1950, 9A (6), article entitled " Caustic Soda Industry " *M/s Tata Chemicals Ltd* point out that the correct production figures for soda ash (p 185) at Dharangadhra and Mithapur Works are respectively 18,000 and 28,000 tons as estimated by the Indian Tariff Board, and not 50,000 tons as reported in the article.

1950, 9B (6), article entitled " Investigation on Indian Radioactive Minerals — III Monazite " page 159, line 7, *for* F_3 (left) *read* P_3, page 159, line 33, *for* P_{11} *read* R_{11}, page 160, L H col, line 6, *for* Th^{+V} *read* Th^{IV}, page 160, L.H col, line 7, *for* P_4^{3-} *read* PO_4^{3-}, page 160, R H col, ref 1 should *read* NANDI & SEN *J sci industr Res*, 1950, 9B, 124

1950, 9B (7), article entitled " Alkaloidal Constituents of the Bark of *B aristata* (*Rassaut*) ", page 161 Since the publication of this paper, the authors have pointed out that the correct m p of Native chloride 2 is 204°C and not 235°C as reported, page 164 the m p of palmatine nitrate is 239°C and not 245°C.

Progress Reports

BOTANICAL SURVEY OF INDIA

EXAMINATION AND IDENTIFICATION OF NEW COLLECTIONS, exploratory tours and reorganization of the Indian Museum, Calcutta, formed the bulk of the work carried out by the Botanical Survey of India during the year (1947-48) under review

Over 2,500 specimens were collected during botanical excursions conducted in the Himalayan ranges of Sikkim, round about Bolepur and Santiniketan, Chota Nagpur hill tracts of the Singhbhum and Ranchi districts, Pareshnath Hills, Topchanchi Lake and hills in east Bihar, Burdwan district, Gopalpur-on-Sea, the islands in the Chilka Lake and parts of the Eastern Ghats in the Ganjam district of Orissa The specimens included live and herbarium specimens of Rhododendrons, Primulas, Corydalis, Anemones, Abies, Juniperus and other alpines

The examination of the collections brought from the little-explored region of the Rampa country have yielded some interesting results Several new records of plants belonging to the Himalayas, Assam, Burma and the Andamans have also been identified

In connection with the putting up of an exhibition of important medicinal plants of British and Indian Pharmacopoeias at the All-India Exhibition, Calcutta, an annotated list of Indian and other medicinal plants classified according to their therapeutical values was prepared The department continued to render useful service as a bureau of information to a large clientele in India and abroad

A review of the progress of botanical studies, conducted in India and included in the report, reveals that during the year under report over 200 scientific papers, covering such subjects as fossils, algae, fungi, ferns, embryology, cytology, ecology, anatomy, morphology, physiology, economic botany, systematic botany and tetratology and plant distribution were published Fifty-five papers were on systematic botany alone The new records which are additions to the published flora of Madras are the following *Hypserpa cuspidata* (Wall) Miers (*Limacia cuspidata* H F and T) (Menisp), *Cochlospermum religiosum* Alston *Paramignya scandens* Craib (Assam), *Zisyphus glabra* Roxb (Burma & Andaman), *Pygeisum acuminatum* Colebr *Bupleurum mucronatum* W & A *Pimpinella heyneanum* Wall var typicum C B C , *Wendlandia exserta*, D C , *Psychotria fulva* Ham , *Linociera malabarica* Wall , *Balanophora indica* Wall , *Balanophora dioica* Brown, *Glochidion assamicum* Roxb , *Curculigo recurvata*, *Ophiopogon intermedium* D Don, *Flagellaria indica*, *Luisa albens* Trin, *Microstegium monanthum* (Nees) *A camus*, *Alectra indica* Benth , *A thomsoni* H F , *Hibiscus pungens* Roxb , *Epithema carnosum* Benth , *Smilax prolifera* and *Vitex penduncularis* Wall var Roxburghiana.

These discoveries confirm the belief that there are still vast tracts in India where even a preliminary exploration has not been conducted, and that the knowledge of the Indian flora is far from complete A very interesting instance of extended range of distribution of a very effective medicinal plant is that of *Vitex penduncularis* var Roxburghiana of Assam, which is an acknowledged specific for the black-water fever This was collected from the slopes of Dumma Konda Hill (Madras) So also *Dichroa febrifuga* of the Sikkim Himalaya can very well be considered a substitute for quinine, Mahonia and Berberis species from which " Berberidin " has recently been isolated are considered to be efficacious in diabetes

The Industrial Section of the Indian Museum has been reorganized and the restoration work has made substantial progress and classification, grouping and exhibition of certain selected exhibits have been introduced Some of the important series are (1) drugs acting on the various systems in man, (2) tropical and sub-tropical fruits, (3) vegetables classified under root vegetables, leaf vegetables, fruit vegetables and (4) fodder

" Story method " of display, a new technique employed in some leading institutions abroad, has been introduced for the first time in the Indian Museum Among the new exhibits arranged on these lines, mention may be made of the " Story of Paddy from Grower to Consumer ", " Story of Tobacco from Field to Factory ", " Story of Rubber ", " Story of Indigo " , each story is told through specimens, photographs, coloured paintings and models A diaroma on " paddy cultivation" consisting of 20 units of 6 models showing ploughing of the field, sowing, transplanting, harvesting, threshing, milling, par-boiling, stacking and transporting, was another exhibit prepared for the museum Other new additions to the museum comprise of interesting and valuable collections of timber, food and fodder crops fibres, cotton, narcotics, beverages, crude drugs, minor forest products, etc

ROAD RESEARCH IN ENGLAND

WORK ON TRAFFIC FLOW, ROAD SURFACINGS AND plant and machinery figured most prominently in the activities of the Road Research Laboratory, Britain, reviewed in the report for the year 1948 (*Road Research*, 1948, *H M S O* , price *2s*)

Preliminary surveys of traffic in built-up areas, utilizing observer-cars, timed over selected stages of the route, have resulted in a technique from which the required data can be obtained with the minimum of labour Methods of conducting " before and after " studies have been devised which should assist highway authorities to assess the value of traffic changes Zebra pedestrian crossings, which had been developed the previous year on a model scale, were tested on a full scale at a few sites with the object of studying the effect on the behaviour of drivers and pedestrians , and a marked improvement in the behaviour of both has been noticed Following a survey of headlamp dazzle conducted during the year, regulations have been issued fixing a minimum height for lamps on vehicles. The work on braking tests has provided information on the best form of testing and on the condition of vehicles on the road

The Laboratory has been successful in developing improved forms of portable automatic traffic counter and speedometer the speedometer can be employed to divide vehicles into speed groups or when connected to a recorder to record data from which the speed of each individual vehicle may afterwards be deduced

An improved method of determining the suction moisture content relationship for soils has been developed and has been employed to examine mathematically the equilibrium of moisture distribution in saturated clays

Research on soil stabilization has been mainly directed to improving the constructional methods used in the soil cement process Experimental trials have shown that the crushing strength of the soil cement is mainly dependent on its state of compaction and the highest strength is obtained at maximum dry density irrespective of the moisture content During an investigation of soils from Abadan Iran it was found that the presence of 1 to 2 per cent of sulphates led to the disintegration of samples of the soil stabilized with cement This was attributed to the crystallization of the salts following the evaporation of moisture from the specimen

A property of aggregates that has so far received little attention viz the degree of roundness of the individual particles has been investigated This property which is the main distinction between gravels and crushed rocks is known to be of significance in road making since it affects the workability of concrete and the stability of bituminous surfacings It has been observed that the proportion of voids in a fully compacted aggregate of a given grading is determined largely by the roundness of the particles

The ultrasonic method of concrete testing developed in 1946 47 involving measurement of the velocity of propagation of an ultrasonic pulse has been found useful in testing the quality of concrete in the actual structural member

A test has been developed to measure the susceptibility of road tar to deleterious oxidation The test is employed to obtain data on reproducibility of tar composition The susceptibility of tars to oxidation can be reduced if the phenolic constituents of the tar are removed

Crystallization of hydrocarbon constituents has been found to develop in certain high aromatic tars thereby affecting their durability on the road The addition of 10 per cent (by weight) of a hard grade of bitumen to the tar was found to retard crystallization It is also prevented if the fluxing oils used in the preparation of the tar were cooled and filtered to remove crystalline material

An empirical test has been developed to determine the amount of potentially crystalline material in a tar the method involves measurement of the amount of crystalline material in the oil distilling from the tar at temperatures below 350°C

FOOD RESEARCH IN BRITAIN

THE REPORT OF THE FOOD INVESTIGATION BOARD D S I R London for the year 1948 (*H M S O* price 9*d*) contains many items of special interest. Notable advances have been made in the development and application of displacement chromatography by means of columns packed with ion exchange materials and of filter paper chromatography These two methods greatly facilitate the quick separation and identification of substances often present in small quantities in complex mixtures and are being applied to the separation and identification of the polysaccharide components of the plant cell wall the isolation of organic bases and amino acids from protein hydrolysates and separation of the flavonoid and anthranoid pigments and other phenolic constituents of plants In order to improve the quantitative analysis of amino acid mixtures on the paper chromatogram a continuous recording device has been developed which measures the change in conductivity at a given place on the paper while the solvent is flowing between electrodes Amino acids do not possess an appreciable conductivity in neutral organic solvents hence a new range of acidic solvents has been developed in which the amino acids largely function as bases The presence of an amino acid in the solvent passing the electrodes effects a distinct change in its conductivity the change being approximately proportional to the concentration of the amino acid

Experiments on the refrigerated gas storage of bananas have revealed that an accumulation of carbon dioxide together with other volatile products of fruit metabolism in the atmosphere do not prolong their storage life Ozone is now being introduced to destroy the ethylene and other volatile substances produced by the fruit the accumulation of which under conditions of restricted ventilation imposed in gas storage appears to accelerate ripening even in the presence of carbon dioxide In this respect apples and pears differ from the banana

An improved method of freezing herrings in metal containers at a higher temperature than by air blast or multi plate freezing methods has been devised Herrings can be frozen down to −15°C in about two and a half hours in brine at −21°C and may subsequently be stored at −20°C with little change of flavour for 4 to 6 months respectively

The study of the physiological factors affecting the ascorbic acid content of cross seedlings and potatoes has revealed that salts which raise the *p*H of the cell sap increase the synthesis of ascorbic acid A relationship has been observed between the ascorbic acid and sucrose content of stored potatoes at 10°C Storage at low temperature produces a temporary increase which varies with the maturity of the potatoes and the length of their previous storage period

Active invertase preparations have been obtained from young Bramley s seedling apples by the alkaline buffer extraction method followed by fractional precipitation

The palatability chemical composition and methods of improving whale meat were examined with a view to utilizing it for human consumption Important relations have been established between the physical conditions of the meat its *p*H and the state of *rigor mortis* Based on these results standards have been drawn up by the Ministry of Food for the inspection of whale meat

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India* Part II Section 1 for June 1950

Agricultural Chemicals

42383 Synthetic polymeric composition *Condensing mono or poly hydroxy phenol and phenol sulphonic acid with an aldehyde in alkaline medium* — The Fertilisers & Chemicals Travancore Ltd

42486 Continuous manufacture of superphosphate *Using a mixture of phosphoric acid or sulphuric acid or both with nitric acid* — Manufactures De Produits Chimiques Du Nord Establissements Kuhlmann

Organic Chemicals

42433 Aromatic nitro compounds 1 *phenyl* 1 1 3-*diacyloxy* 2 *acylamino propane is nitrated with sulphuric acid nitric acid mixture to obtain* 1-*para nitro phenyl* 1 3-*diacyloxy* 2 *acylamino propane* — Parke Davis & Co

41560 New dyestuffs *Treating thiourea with compound containing at least one halogen substituted methyl group linked to aromatic nucleus through an atom or group* — I C I Ltd

Food & Kindred Products

42701 Refining vegetable and animal oils *Neutralising insufficiently free fatty acids followed by precipitating pigment and colouring matter by means of strong lye* — Aktiebolaget Separator

Metal & Metal Products

41831 Nodular cast iron *Melting a carbide metal stabilising agent to a molten condition then graphitising the melt and pouring a casting from the melt* — Smalley

41832 Desulphurization of iron and steel with metal hydrides *Introducing a reagent comprising at least one metal hydride in a mass of molten ferrous metal to reduce sulphur content* — Smalley

41837 Distillation of aluminium from aluminium alloys *Repeatedly circulating the molten metal through a low pressure reaction chamber from two accessible reservoirs at normal pressure* — International Alloys Ltd

Rubber & Rubber Products

42519 Condenser rubbing aprons for textile apparatus *Apron as an endless belt has at least operative surface formed of natural or synthetic rubber composition and grooved helically from end to end* — Andre Rubber Co Ltd & Clements

Stone Clay & Glass Products

42215 Hydraulic cement compositions *Containing* 0·0005 *per cent to* 0·1 *per cent based on the weight of cement of an alkylphenyl sulphonate containing* 9 *to* 18 *carbon atoms* — The Master Builders Co

Textile & Textile Products

42144 Automatic looms for weaving *Shuttle having a recess to be engaged by a weft cutter when the shuttle is properly boxed but the cutter when incorrectly positioned is pushed to put the cop leading mechanism out of action* — Shimwell

41756 Breeding and rearing apparatus for silk worms *The frame having plurality of trays and the movable trays arranged each above the fixed trays* — Jares

42728 Apparatus for dyeing yarn in package form particularly to spindles for supporting packages during the dyeing process *A spindle assembly comprising a solid rod in threaded engagement with a tapered socket having a solid portion and a longitudinal bore for passage of dye liquor* — Stienen

Miscellaneous

42328 Manufacture of carbon moulded bodies *Moulding to the desired shape a mixture of powdered coal and plasticising agents and firing the moulded shape under non oxidising conditions at a controlled rate of temperature* — C D Patents Ltd

42635 Sifting sieving or sorting machines for tea or other commodity *The sieve is actuated by a driving shaft which has a counterweight mounted thereon which keeps the machine in balanced position* — Dewar & McLeod & Co Ltd

40668 Lubricating compositions *Consist of a lubricating oil base and a minor proportion of the salt of petroleum sulphonic acid and a polyvalent metal salt of an organic dithiophosphoric acid* — Wakefield & Co Ltd

41003 Colour correction in colour photography *Stepping up the densities of the magenta and yellow image layers of a transparency positive or negative by an orange filter in a positive process or a cyan filter in a negative process during the exposure of the film* — Hattandi

42257 Improved windmill *Multiplicity of wings having concave and convex side both lengthwise and breadthwise wings being secured to rings on a shaft held vertically over the tower* — Chaudary

41688 Improved windmill *Comprising a framework supporting a vertical driving shaft rotated by two or more pairs of wings located one above the other each pair comprising two blades hingedly mounted at their upper edge to a frame fixed centrally to upper part of the driving shaft* — Green

Patented Inventions of the Council of Scientific & Industrial Research

STABILIZED DIAZO SALTS & ISODIAZOTATES

Patent No. 33261

R J Moualim & K Venkataraman

Stabilized diazo salts and isodiazotates are prepared from mono- or di aminoanthraquinones for use in dyeing and printing The diazotization is effected by making a fine paste of the powdered base with concentrated hydrochloric acid and adding solid sodium nitrite One molecule of the base requires 7 to 10 molecules of hydrochloric acid Diazotization is carried out with the theoretical amount of sodium nitrite and the end point is determined by using starch iodide as indicator The diazo salt is precipitated either by adding anhydrous sodium sulphate or zinc chloride to the diazotized solution The diazotized base or solution is treated with caustic soda or caustic potash for obtaining stable isodiazotates A 50 per cent aqueous solution of the alkali is used a mixture of the diazotized base or solution and the alkali solution is heated to a temperature ranging from 115° to 125°C for the separation of the isodiazotates

Excellent yields of the diazo salts of remarkable stability to heat are obtained by employing this new method of diazotization which also avoids the use of expensive solvents The diazo salts prepared in this manner are readily soluble in water and give a variety of shades including yellow, red, maroon, claret, brown and black when coupled on the fibre with commercial ‘naphthol The azoic dyeings are of good fastness to dry rubbing and of moderate fastness to wet rubbing All the combinations except the blacks and yellows are of excellent fastness to bleaching The kier-boiling fastness is good the yellow and orange-brown shades being of inferior fastness The fastness to light is excellent for all combinations

2 : 4-DICHLORO-1-AMINOANTHRAQUINONE

Patent No. 34211

British Patent No 634646

S G Bedekar & K Venkataraman

According to the present invention, 2 4-dichloro 1-aminoanthraquinone is prepared by directly chlorinating α-aminoanthraquinone in glacial acetic acid suspension by bubbling dry gaseous chlorine through the suspension at 90° to 100°C The product thus obtained is purified by crystallization from suitable organic solvents like solvent naphtha

Example — Ten parts of α-aminoanthraquinone are suspended in 100 parts of glacial acetic acid and at 100°C, 8 5 parts of dry chlorine are passed in at a moderate rate A vigorous mechanical agitation is maintained during the reaction which is complete in 3 hr At the end of the reaction the mixture is cooled and the product crystallizes out The crude product so obtained may be purified by recrystallizing from solvent naphtha

When pure, it is in the form of reddish-brown needles m p 205°C It dissolves sparingly in ether and readily in glacial acetic acid and solvent naphtha The solution in concentrated sulphuric acid is yellow

ANTHRAQUINONE ACID DYESTUFFS

Patent No 34210

British Patent No 634645

S G Bedekar & K Venkataraman

The authors have found that the 2 4-dichloro 1 aminoanthraquinone can be conveniently employed for the manufacture of acid dyestuffs 2 4-Dichloro-1-aminoanthraquinone is heated with an organic base such as aromatic amine if desired, in the presence of a catalyst or acid binding agent, the product being sulphonated prior to or following purification Examples of organic bases used are *p* toluidine, aniline

Example — Three parts of 2 4 dichloro 1 amino-anthraquinone are dissolved in 30 parts of amyl alcohol and refluxed with 5 parts of *p*-toluidine, 1 part of anhydrous sodium acetate, $\frac{1}{10}$ part of anhydrous copper sulphate and $\frac{1}{10}$ part of copper bronze, till the reaction is complete The solvent is then removed by steam distillation and the residue is purified by washing with 40 parts of a hot, low boiling organic solvent like alcohol The purified product is sulphonated by treatment with 5 parts of sulphuric acid monohydrate at 100°C so as to obtain a product soluble in boiling water

The products dye a beautiful blue on wool The dyeings possess good fastness properties

The Indian Salt Industry

THE Report of the Committee of Salt Experts constituted by the Government of India in April 1948 which has now become available deals comprehensively with the present position of the Indian salt industry and discusses the directions in which the industry should be developed so that it may attain within a short time the status it is entitled to by virtue of its importance as an article of food and as a basic raw material for the heavy chemical industry With the abolition of the excise duty on salt the present Salt Department of the Government of India has ceased to be a revenue-collecting organization its functions have to be oriented to those of a development department How should the Department be reorganized so that it may fulfil its new responsibilities? What are the problems of the salt industry which await investigation and research so that it may develop into its full stature? These are the questions which the Report discusses in a refreshingly realistic manner

The Committee confirms the view generally held in knowledgeable circles that salt production in India can be increased within a short period and that self sufficiency with regard to this vital requirement of the population can be attained Urgent as the improvement in quantitative production is the need for raising the quality of salt and for recovering the valuable by products of the salt industry is no less urgent and important It must be emphasized that common salt has the unique distinction of being the foundation material for the great modern chemical industry The Leblanc process for making soda ash from common salt is regarded as the beginning of the inorganic chemical industry Competent authorities aver that the electrolytic chlorine cell is the fundamental basis of the prodigious array of organic chemicals The production standardization and utilization of a raw material so basic to the chemical industry and yet so abundant should necessarily receive serious attention The example of *Dow Chemicals Ltd* illustrates the possibilities for the production of chemicals from the limitless deep and thanks to the research programme consistently fostered by the enlightened founder of the organization Dr Herbert Henry Dow a gigantic chemical industry based on common salt has been built up That similar possibilities exist in India has been amply demonstrated by the pioneering efforts of the late Mr Kapilram H Vakil who planned and directed the salt works and the by product plants at Mithapur Such developments are however exceptional the Indian salt industry remains by and large in a recumbent and primitive condition and traditional rule of thumb methods uninfluenced by modern technological developments operate in salt production The salt manufactured in many areas is sub standard and that in some areas such as Didwana is unfit for human consumption The industry is in dire need of technical aid and the time has arrived for directing serious attention to improving the quality of Indian salt

The industrial plants at Mithapur for the systematic recovery of magnesium chloride magnesium sulphate potassium chloride bromine and more recently gypsum provide an object lesson in the utilization of marine salts for the development of chemical industry The unique resources of the land locked lakes of Rajputana have so far received but scanty attention These inland lakes represent vast chemical reservoirs constantly replenished by streams flowing over salt bearing beds The spontaneous salt formed in the Rann of Kutch and distributed over the catchment area of the lakes by stormy winds is dissolved by rain water and carried to the lakes whose salt contents are thus continuously enriched The resources of some of these lakes are inexhaustible Like the Salt Lakes of California and Nebraska the Great Salt Lake of Utah and the Dead Sea the Rajputana desert lakes provide resources which await exploration and planned exploitation Climatic conditions prevailing in the lake areas are conducive to the development of the industry Low rainfall long periods of dry weather high winds and fairly high temperature provide ideal conditions for solar evaporation The climate is a most valuable asset next only to the richness of the lakes By supplying proper conditions for the crystallization of marine salts it is possible to separate the valuable salts from those of lesser value and individual salts from their mixed solutions *The Desert Chemical Co* of California recovers from the saline water of the Dale Lake (which is similar in many respects to the lake water of Didwana) not only common salt of high quality but also the valuable by product sodium sulphate The *Palestine Potash Ltd* has been exploiting the resources of the Dead Sea for the extraction of potassium salts and bromine Science and technology provide the means for utilizing the natural resources of the inland salt lakes for building up chemical industries

The waters of Sambhar and Didwana lakes are rich sources of sodium sulphate sodium carbonate and sodium bicarbonate For every ton of common salt recovered from Didwana Lake it is possible to recover $\frac{1}{8}$ to $\frac{1}{4}$ ton of sodium sulphate This valuable material has many industrial applications among which may be mentioned the production of caustic soda and sulphuric acid by electrolysis The recovery of all these by products would not only help in building up a flourishing chemical industry but at the same time also improve the quality of salt produced and lower the costs of production

The Indian salt industry poses many problems for solution The Salt Research Committee of the Council of Scientific & Industrial Research which is fully seized of their importance has already initiated a few research projects of practical importance The Committee of Salt Experts has recommended the establishment of model factories with facilities for undertaking large-scale development programmes in the more important salt producing regions This recommendation is opportune and must be welcomed If this recommendation is accepted and brought into effect new facilities would become available for the commercial utilization of the results of research and inquiry sponsored by the Council of Scientific & Industrial Research Knowledge and means for acquiring more knowledge required for solving the problems of the salt industry exist What is needed now for developing the industry is a determined effort by all concerned — scientists technologists and industrialists—to put knowledge into action to transform plans and visions into plants and processes

Characteristics of the Ionosphere over Calcutta (June 1950)

S S BARAL R K MITRA D C CHOUDHURY,
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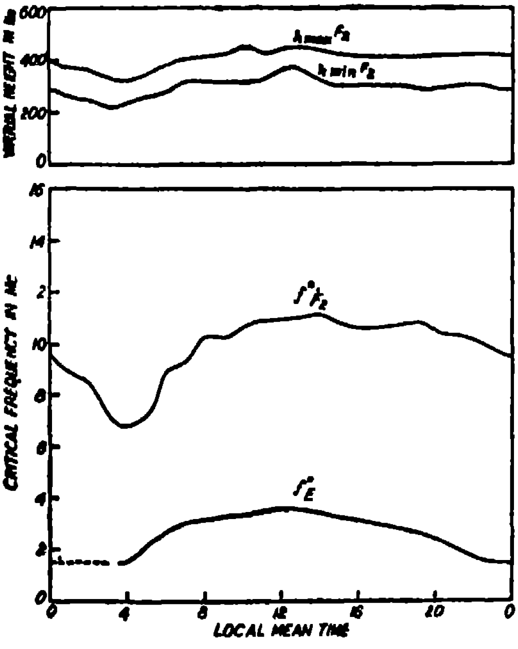
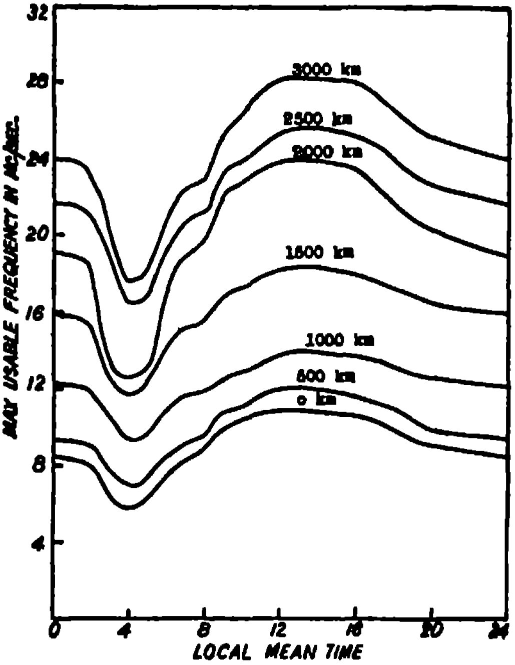
THE following are the ionospheric data observed at Calcutta for the month of June 1950

The mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 are represented in Fig 1 in graphical form The figures are obtained from average values of data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies for different distances of transmission by reflection at the F region over Calcutta for the month of September 1950 Table I records the occasions when during routine observations when sporadic E ionization was observed and the corresponding values of penetration frequencies and heights



5 HOURS 54 MINUTES AHEAD OF G M T
FIG 1 — JUNE 1950



AT POINT OF REFLECTION
FIG 2 — PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF SEPTEMBER 1950

Sporadic E ionization was found to occur frequently during evening and night and sometimes during the afternoon Sporadic E occurred more frequently during night than during day in the present month Region F_2 ionization was found to remain steady up to midnight and during the evening there was a slight rise The fall in ionization during night is very slow and the lowest value of f°F_2 reached (6 8 Mc /s) is several times larger than the corresponding value (3 0 Mc /s) during the last winter months

TABLE I

MONTH & YEAR	DATE	HOURS	$f^{\circ}E_s$ Mc	$^{h}E_s$ Km.
June 1950	1	00 00	6 00	120
		01 00	3 70	105
		02 00	3 50	105
	2	18 00	3 20	90
		22 00	4 10	105
		23 00	5 00	120
	3	00 00	4 20	105
		01 00	4 10	120
		02 00	3 20	105
	6	18 00	4 20	105
		19 00	4 20	120
		20 00	3 60	135
		21 00	4 00	120
		22 00	3 50	105
	7	17 00	3 70	105
		18 00	4 25	120
		19 00	8 00	135
		20 00	8 15	150
		21 00	6 20	150
		22 00	4 50	150
		23 00	4 00	135
	8	06 00	5 00	135
		07 00	4 20	120
	9	01 00	5 00	135
		02 00	4 20	120
	14	20 00	4 15	120
		21 00	3 70	105
		22 00	3 50	105

TABLE I — *contd*

MONTH & YEAR	DATE	HOURS	$f^{\circ}E_s$ Mc	$^{h}E_s$ Km.
June 1950	15	20 00	3 35	105
		22 00	4 00	120
	16	00 00	9 50	150
		17 00	4 15	135
		18 00	4 15	135
		21 00	3 00	120
		22 00	4 00	105
	17	09 00	3 70	90
	19	22 00	3 00	105
	20	02 00	4 05	105
		03 00	4 50	120
		04 00	4 50	120
		16 00	4 50	120
		17 00	4 00	105
		18 00	4 05	120
	21	21 00	3 85	105
		22 00	3 85	90
		23 00	4 10	120
	22	23 00	3 00	105
	23	00 00	4 25	120
		04 00	3 00	105
		23 00	3 60	105
	24	00 00	4 05	105
		01 00	3 00	120
		03 00	3 40	105

Electronic Meteorological Instruments in the India Meteorological Department

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THE techniques of electronics have found application in many branches of experimental science In meteorology, the tendency to use these techniques has been growing rapidly and, in India, various instruments employing radio tubes are being designed or are being used for meteorological observations on the ground and in the upper air. Some of the instruments designed and in use by workers in agricultural meteorology at Poona have been described in a paper by Ramdas[1] The present paper describes briefly a few of the other instruments designed or in use in the India Meteorological Department.

The Radiosonde

The first instrument to be designed and constructed was the radiosonde to measure the pressure, temperature and humidity in the upper air This consists of a meteorograph in which the elements which vary with pressure, temperature and humidity modulate a light single-valve wireless transmitter on a wavelength of about 4 metres. The wireless signals are received and recorded on the ground with special equipment and the data evaluated Two types of instruments are in use by the Department one of which was developed at Delhi and employs a small clock work rotating a special contacting arrangement to transmit the signals This is in regular use at four observatories in India The second type (FIG 1) which was designed at Poona and is now in use at eight stations in India employs a paper fan rotating during the ascent of the balloon and operating a different type of switching arrangement These instruments have been described in some of the publications of the India Meteorological Department[2 3] Many accessories required for their manufacture calibration etc have been designed and constructed[4 5] The ground equipment to receive and record the wireless signals from the F type meteorograph sent up with the balloon is shown in Fig 2

The Radar

A later and more recent application of electronic equipment for the measurement of meteorological elements has been made by using the radar Knowledge of the speed and direction of the wind in the upper air is helpful for the forecasting of weather and this information is normally obtained by observing the movement of hydrogen filled balloons with the help of theodolites This method fails completely during bad weather as the balloon cannot be followed

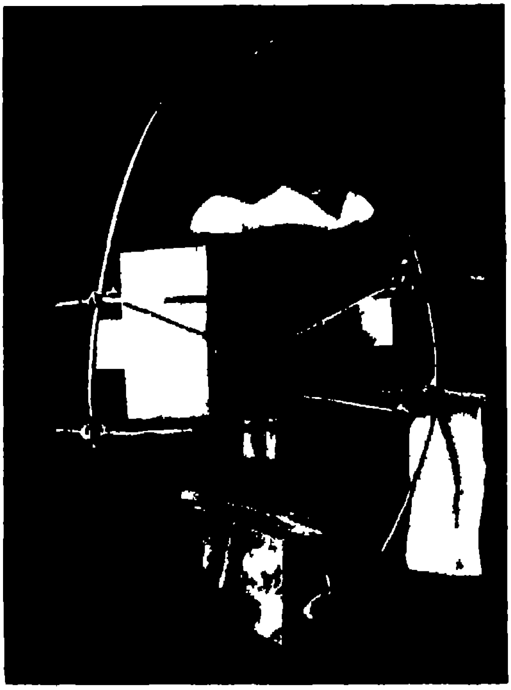

FIG 1 — F TYPE METEOROGRAPH

FIG 2 — GROUND EQUIPMENT TO RECEIVE AND RECORD WIRELESS SIGNALS FROM THE F TYPE METEOROGRAPH

when it enters the cloud No information about winds will, therefore, be available above the cloud base. This difficulty has been overcome by the meteorologist by adapting the radar for this purpose. An artificial target is suspended from the hydrogen-filled balloon to reflect the energy from the radar transmitter and this enables the position of the balloon to be located in the sky. It is thus possible to obtain information about upper winds to great heights even above the cloud base and at night when the usual theodolite method fails

The India Meteorological Department has acquired a few radars which are being used regularly at the observatories at New Delhi and Poona This radar (A A No. 3, Mk III) is of the early type and works on a frequency of 204 mc One Yagi array is used for transmission and four Yagi arrays are used for reception through a lobe switching arrangement (*see* Cover). The range is determined by an automatic range unit. The balloon is tracked both in elevation and azimuth by two observers and one observer keeps note of the range Corner reflector type of targets are efficient at microwaves, but they are not so effective at 200 mc. and, therefore, crossed dipole targets are used, which absorb the radiation of the radar transmitter and re-radiate.

The method of determining upper winds with the radar by using a passive target, i e a target which does not originate a signal but merely reflects the incident energy, has some disadvantages. Usually, only shorter ranges are obtainable with radars The greatest handicap is the ground clutter and other unwanted echoes which tend to mask the desired signal. This difficulty can be overcome if, instead of a passive target, a small wireless transmitter on 204 mc is attached to the balloon, which can be followed with the receiving equipment of the radar. Equipment employing active targets is more expensive, if employed only for obtaining upper wind information. However, active targets are employed in all types of radio-meteorographs and, as such, it should be possible to track them with the receiving equipment of the radar for upper winds. Maximum advantages will be obtained from the radar if it can be used to follow both active or passive targets. When an active target like the radio-meteorograph signaller is followed, the transmitter in the radar set will not be operated.

Earlier observations on the influence of the troposphere were found to be most marked for radio-wave trajectories near the surface of the earth, and they were mostly reports of unorthodox vision beyond the geometrical horizon, maximum ranges sometimes extending to even ten times the distance of the geometrical horizon. This started a new branch of study of propagation of these waves and how they are influenced by the meteorological conditions of the atmosphere Some interesting observations regarding the behaviour of the radar waves on 204 mc, when employed to follow balloons carrying dipole targets, have been made at Poona. It is observed that in certain seasons and under certain temperature and humidity distributions, reflections from the balloon target are lost below certain angles of elevation Detailed examination of this phenomenon is on hand.

Though the India Meteorological Department has, at present, the old type of radars operating on a wavelength of 1 5 metres, it is most likely that a few radars operating on much lower wavelengths, of the order of about 10 cm. or less, may be obtained in the near future When radio waves are incident on rain drops, a part of the energy is absorbed and a part is scattered Due to these processes, the incident beam is attenuated and this effect increases as the wavelength is reduced. The effects are not important on wavelengths of one metre and above, but become appreciable at wavelengths of 10 cm. and below The scattering by water drops or precipitation in frozen form are observed as radar echoes, and the meteorologist is able to get from them an idea of the distances of the region of precipitation and also the distribution of rain in the weather phenomenon. Radars operating on such short wavelengths can be used both for tracking balloons with suitable targets for determining upper winds and in connection with storm detection and consequent improvements in short-range weather forecasting.

Distant Reading Wind Instruments

With the increased use of aviation for civilian transport, the demand for meteorological reports from aerodromes have also increased considerably. The data have to be

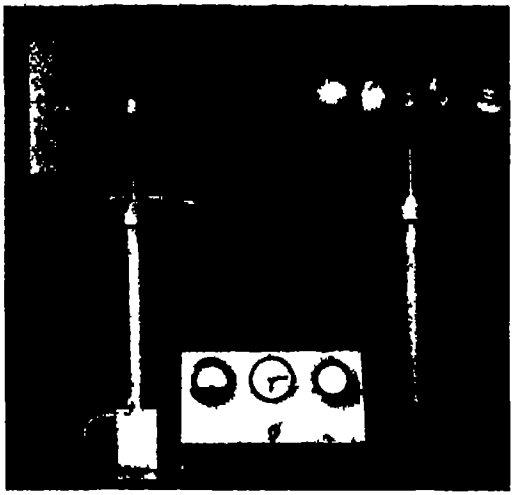

FIG 3 — THE DISTANT READING ELECTRONIC WIND SPEED INDICATOR

supplied both to the planes in the air and on the ground with the least delay Different types of instruments have been designed to measure the velocity and direction of the surface winds from the room of the observer without going up to the anemometer or windvane which are usually located in places which are not easily accessible The Instruments Section at Poona has developed a distant reading wind speed indicator and a windvane using Selsyn motors[6] (FIG 3) In the electronic wind speed indicator a radio frequency voltage of 30 kc is generated in the observer s room and fed through a pair of cables into a coil fixed in a box at the foot of the spindle of the 4-cup anemometer Another coil is fixed just below the first and the voltage induced in this is fed to an amplifier in the observer s room through a pair of cables A brass circular vane with ten sectors fixed on the anemometer spindle rotates in the space between the two coils and varies the mutual inductance between them The induced voltage in the secondary coil is modulated by the rotation of the vane and the modulation frequency will be proportional to the rotation of the spindle i e the velocity of the wind The induced voltage is amplified and the varying portion of the voltage which is obtained after detection is converted into square wave pulses of constant amplitude and then fed into a frequency discrimination circuit which indicates the frequency of the modulation by means of a microammeter calibrated in miles per hour The direction of the wind is obtained at a distance by coupling a Selsyn motor to the spindle on the vane

The Ceilometer

The knowledge of the height of low clouds is very important to the aviator At night it is determined quickly by measuring the angle of elevation of the illuminated patch under the base of the cloud from a vertical beam of light from a searchlight situated at a known distance from the place of observation However this method can not be used during the day A photo electric method of measuring cloud heights in the day time has been developed in the U S A The light spot on the cloud cannot be seen in the day time as the brightness of the underside of the cloud is very much brighter than the spot When a modulated light beam is used and a photoelectric telescope which is sensitive only to the modulated beam and not to the steady light of the day is employed the angle of elevation of the illuminated patch can be determined It appears that the circuit we have already employed in the Poona electronic anemometer appears to be suitable for this purpose Steps are being taken to design in our laboratories a ceilometer on the above lines which can be used to determine the height of the base of clouds both by day and by night

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4 VENKITESHWARAN S P ibid 11 No 134

5 VENKITESHWARAN S P KESAVAMURTHY A HUDDAR B B & GUPTA B K ibid 11 No 133

6 KESAVAMURTHY A & VENKITESHWARAN S P *Under publication*

Fluidization — A New Technique : Part I

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ONE of the outstanding achievements of chemical engineering in recent years which has revolutionized a number of industries and which has opened up new possibilities in other industries is the technique of fluidization It is only in recent years that the importance of this technique is being more and more realized and a number of countries including India are engaged in intensive research on its applications In this paper, an attempt has been made to present the salient features of fluidization its applications to a few industries, and indicate the recent trends in its development

The imparting of certain fluid characteristics or properties to solid particles is known as fluidization When a stream of fluid is passed upwards through a mass of solid particles, reproducible changes in physical behaviour are observed which pass through successive stages as the velocity of the fluid is increased When the velocity of fluid flowing up through a mass of solid particles is insufficient to lift or support any of the solid, the mass is called fixed or moving bed depending on whether the solid is stationary or moving with respect to the container With increasing fluid velocities in the absence of chanelling, the pressure drop through the bed rises until it approaches the net effective weight of the solid per unit area, when the packing arrangement of the particles becomes more open so that the bed expands, with further slight increases in velocity, the particles are fully supported and the expanding bed becomes fluidized Just at the point of fluidization the mass may form a quiescent fluidized bed. With liquid-solid systems, further increases in fluid velocity give a progressive separation of the particles which remain individually and uniformly dispersed in particulate fluidization With many gas-solid systems, the bed expands to only a limited extent and a portion of the gas tends to accumulate in gas pockets or bubbles passing through the fluidized bed in aggregative fluidization In small tubes, the bubbles may grow to a size substantially filling the cross-section of the vessel resulting in slugging Normally, however these bubbles remain small with respect to the vessel and the mass becomes a turbulent fluidized bed Such a turbulent bed can even be maintained above the free-falling velocity for the solid particles in a gas-solid system if the rate at which solids are fed is kept high enough Finally, if the fluid velocity is still further increased or if the solid feed rate is too low the surface of the fluidized bed disappears and the whole mass becomes a dispersed suspension

The variation of pressure drop with increase in the velocity of fluid is shown in Fig 1 It will be noticed that the pressure drop increases with increase in fluid velocity up to the fluidizing stage when it becomes fairly constant and remains independent of further increase in the velocity of fluid In Fig 2 are shown the relationship of bed height with fluid velocity and fractional voidage with fluid velocity

When the solid particles are in turbulent fluidized state or in dispersed suspension, they flow through pipe lines and valves as easily as if they were liquids They also respond to pressure heads The turbulent motion of solid particles in the fluidized state also leads to homogeneous mixtures being formed rapidly, or if suitable arrangements are made to measure the temperatures at different regions of the bed, it will be seen that equalization of temperature takes place throughout the bed The freedom of movement which solid particles possess when in this state is analogous to the freedom of movement which distinguishes the molecules of a fluid from those of a solid. Hence the term fluidization has been given to the process

The first outstanding application of fluidization technique was to the Winkler gas generator developed in Germany as long back as 1929. This was followed by its

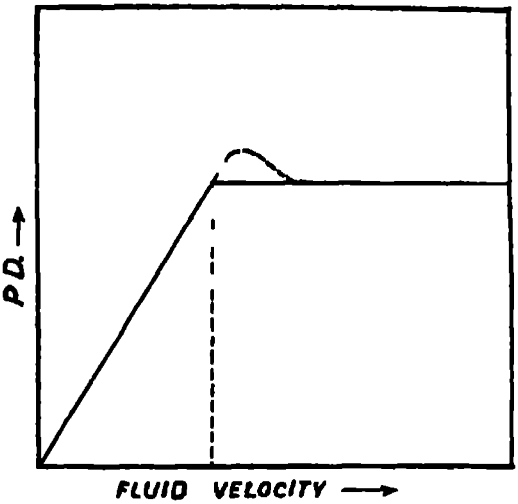

FIG 1 — VARIATION OF PRESSURE DROP WITH INCREASE IN FLUID VELOCITY

adoption to the catalytic cracking of petroleum in the United States its success in this process led to a widespread recognition of the technique as a new method of handling solids In recent years the technique has been applied to the synthesis of liquid fuels gasification of coal washing of coals purification of town s gas from sulphur conversion of sulphur dioxide to sulphur trioxide and the oxidation of naphthalene to phthalic anhydride and a score of other processes

The salient features of the fluidization technique are as follows

1 The fluidized bed of solid particles acts like a thermal fly wheel transferring heat from one hot part of the system to the cooler part and so the control of temperature of the reaction is easier This is due partly to the rapid motion of the solid particles but also due to the fact that powdered solid particles impart heat capacity to the fluid and guard against rapid temperature changes

2 The rapid motion and frequent collisions of particles prevent the development of abnormal conditions in localized areas In the usual static bed with a stream of fluid percolating through it the reaction will have proceeded to a greater extent in the front layers than in the back But in a fluidized bed uniform conditions are very quickly established and relatively easy to maintain Consequently it is possible to operate with a much deeper bed and this is a very important practical advantage that may have a deciding influence on the economic possibility of the process

3 The fluidized bed of solid particles resembles somewhat a boiling liquid one characteristic which they have in common is a high rate of heat transfer This is obviously advantageous where heat exchange is a primary object but it is also a desirable feature when exothermic chemical reactions take place in the fluidized bed because it makes possible the maintenance of a high through put without fear of temperature becoming excessive

4 When a chemical reaction is taking place between a gas and a solid the effect of increase in surface due to the solid particles being in a fluidized state as compared to the static bed will lead to a higher reaction rate This is so because of the continual relative movement of the individual particles whose surfaces are kept fresh by collisions and the streaming gas which reduces the film resistance between the reactants

5 And finally it offers an easy method of moving large quantities of solids from one part of a process to another and is adaptable to continuous as opposed to intermittent or batch operations

As opposed to these main advantages there are two outstanding disadvantages of the fluidization technique The first is that the rapid mixing and turbulent motion of the particles leads to a greater degree of short circuiting by the solid between its entrance and its exit than in the case of the conventional static or moving bed It is therefore not possible to use this technique to achieve counter current flow effect between solid and fluid

The second objection applies to those processes in which the solid is undergoing change during a reaction that is in general to the non catalytic processes Here a difficulty is encountered by the need of maintaining always a suitable gradation of particle size in the fluidizing column The particle size will be reduced during the reaction For example in the gasification of caking coals due to the agglomerating property the coal particles will stick to one another resulting in the collapse of the fluidized bed However this may be overcome by including with the solids certain

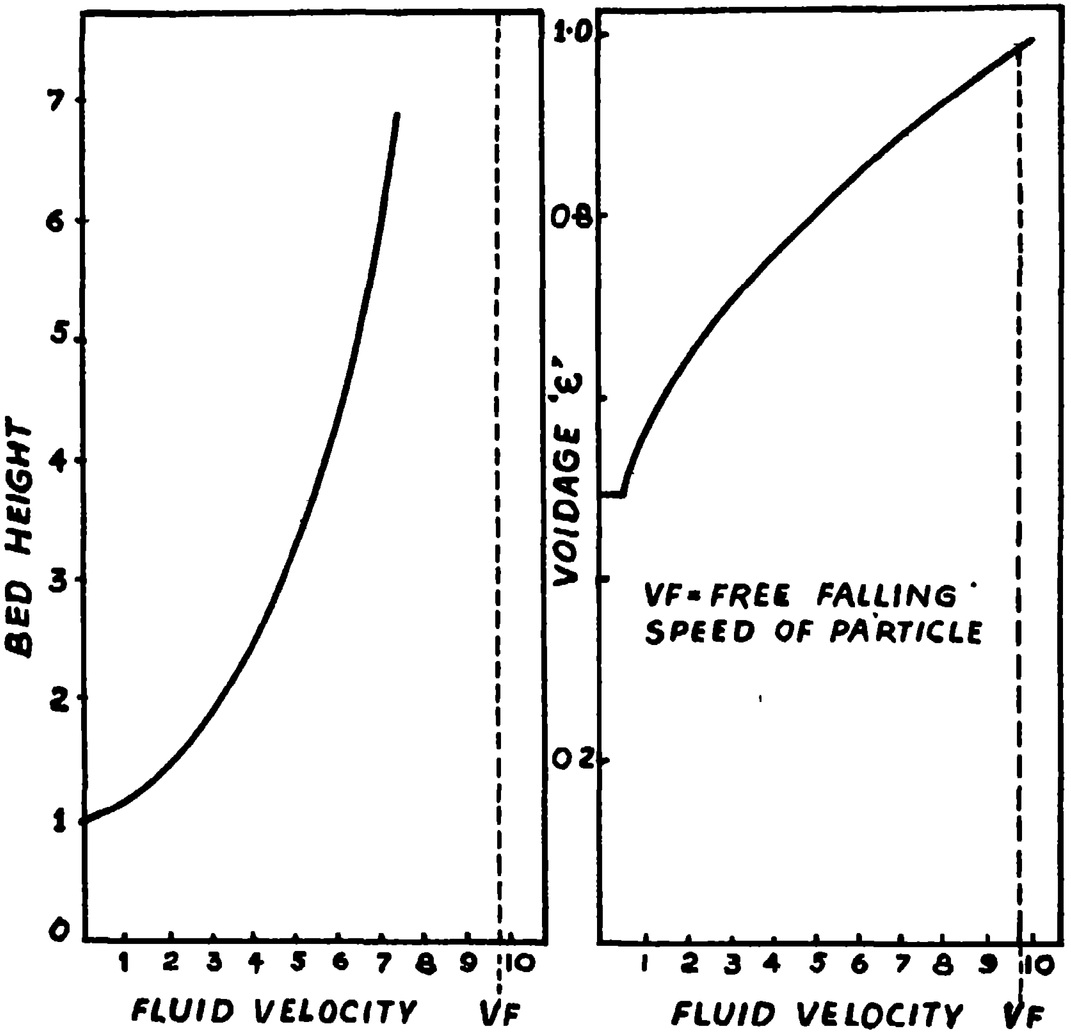

FIG. 2 — RELATIONSHIP OF THE BED HEIGHT AND VOIDAGE WITH FLUID VELOCITY

amount of inert diluent which, by keeping the particles apart, will reduce the agglomerating property

The first large-scale application of fluidization technique was to the Winkler gas generator[3]. In pre-war Germany the demand for hydrogen for use in the synthesis of ammonia and liquid fuels was so great that it could not be met by errecting the conventional type of water gas generators as the large amount of coke needed by these plants was not available. One of the pressing problems was to obtain hydrogen or synthesis gas by using the brown coals, which were available in large quantities, as the starting material. This was solved by installing the Winkler gas generator.

The generator is shown in Fig. 3. The body of the producer is a tall steel cylinder, 65′ high and 18′ in dia.; a flat grate forms the bottom of the generator. Coal crushed to 3 mm dia. is fed through the conical coal bunker through a screw conveyer to the top of the grate to a height of about 3′ to 5′. A blast of oxygen and steam (if a water gas of a high calorific value is needed) or air (if producer gas alone is needed) is passed to the bottom of the fuel bed through the slots provided at the bottom of the grate. The blast fluidizes the fuel bed and gives it the appearance of a boiling liquid. The fluidized bed has a temperature of about 900°C. The large amount of space provided over the fuel bed is to facilitate the complete gasification of the carry-over fuel by introducing a stream of secondary oxygen.

The rating, that is the amount of fuel consumed per square foot of grate area, is nearly 1½ to 3 times the normal " blow " and " run " gas, that is, about 40 tons/hr normal rating for a grate 18′ in dia producing 1,80,000 cu ft per hour of water gas. The percentage of oxygen in the blast is usually about 20 but it can be as high as 50. The ash tends to segregate by reason of agitation of the bed and is removed by a conveyer screw

The next large-scale application of fluidization technique was to the catalytic cracking of petroleum oils whereby some of the high-boiling fractions of the oil are converted to the more valuable motor spirit components

The original process for cracking of petroleum oils was a thermal process in which gas oil or paraffin oils were partly converted into light oils suitable for motor spirits by subjecting them to high temperature

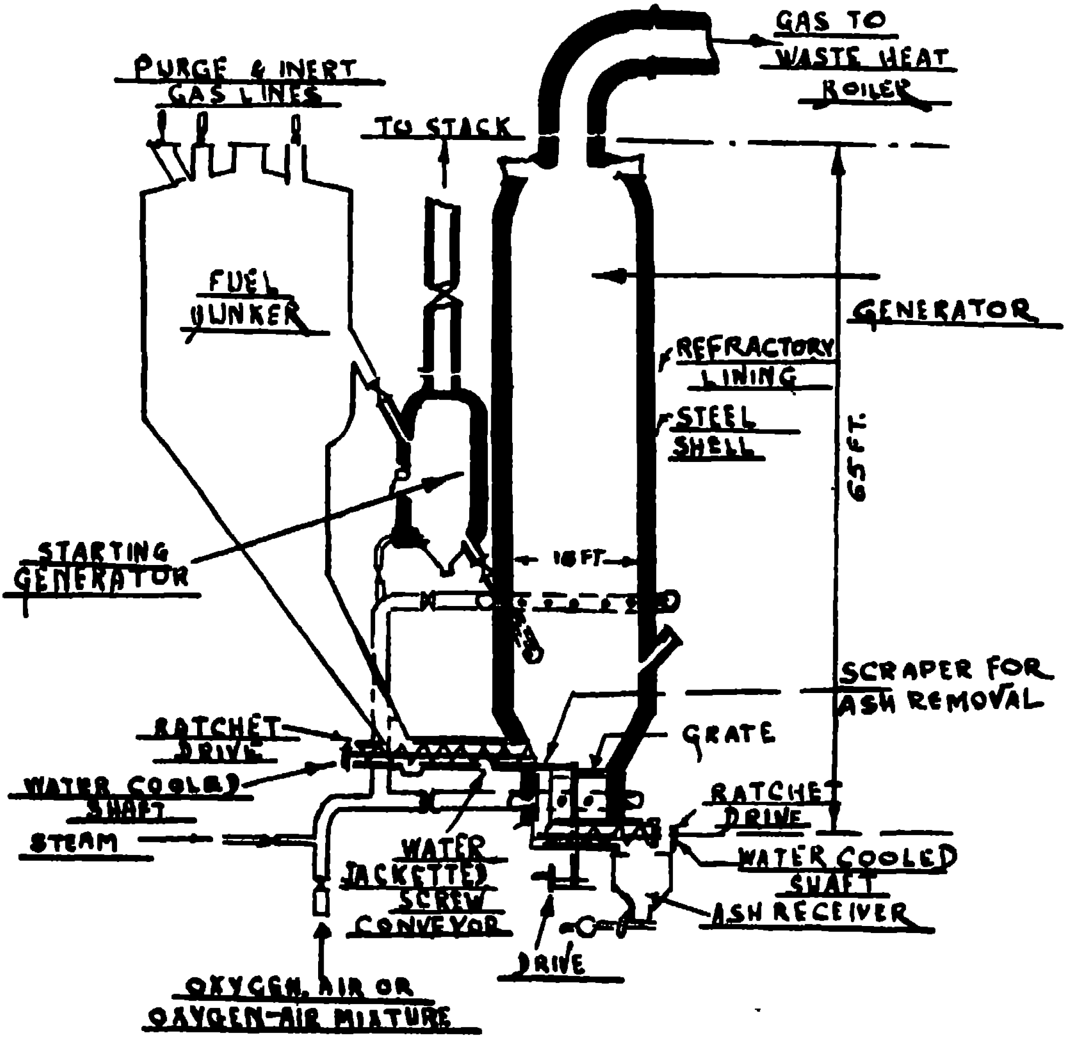

Fig 3 — The Winkler generator

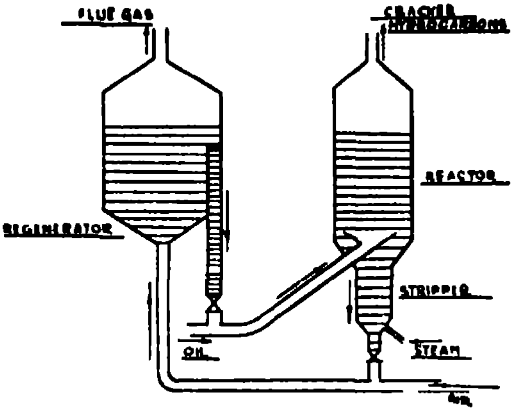

FIG 4 — SCHEMATIC REPRESENTATION OF THE PLANT EMPLOYING FLUIDIZATION PROCESS FOR THE CATALYTIC CRACKING OF PETROLEUM OILS

treatment Later on it was found that the same objective could be achieved yielding a better quality product by passing the vapours of the oils over a suitable catalyst In the Houdry process the catalyst comprising of activated natural clay or synthetic catalyst of the silica-alumina type was in pellet forms, kept over fixed beds, and the oil vapours were passed over it But the selective molecular breakdown of oils by catalysis is accompanied by carbonaceous deposits on the surface of the catalyst This reduces the efficiency or activity of the catalyst and would ultimately inactivate it completely The successful operation of the catalytic cracking of petroleum oils, therefore, depended on the continuous regeneration of the spent catalyst This problem was solved by the application of fluidization to the process The process is schematically represented in Fig 4 The catalyst in a fine state is entrained by oil vapours and in this condition is conveyed to the reactor Here the catalyst is maintained in a fluidized state and in this condition the vapours come into better contact with the catalyst The cracked hydrocarbons are separated from the top The spent catalyst is drawn from the bottom, entrained by a stream of air and conveyed to the regenerator. Here the carbon on the catalyst is burnt and the regenerated catalyst is ready again to be entrained by a fresh stream of the oil vapours Thus the cycle of operation is completed.

Although high concentrations of solid are maintained in the reactor and regenerator, the mixture is extremely turbulent and each particle is in rapid motion. It is found that the turbulence results in a very uniform temperature throughout the mass — even in the large-scale reactors the temperature variation between the top and the bottom of the bed is not more than 5°F. in the range 800° to 1,000°F. for the reactor and 1,000° to 1,200°F. for the regenerator The temperatures are varied by changing the amount of heat applied to the oil vaporizer or by altering the amount of hot catalyst in circulation The degree of cracking of oil vapours depends on the depth of the catalyst bed and on the ratio of the catalyst to the oil vapours, both of which are controllable. It will be appreciated that the fluidization technique has given considerable flexibility to the cracking operation, a quality which is very important from the point of view of process adaptation

The fluidized bed in the reaction vessel may contain as much as 75 to 100 tons of catalyst in the reactor and 150 to 300 tons in the regenerator The rate of flow in the different sections of the plant is controllable by sliding valves

There are about 40 plants in the United States alone using the fluid-catalyst system for oil cracking and some have a capacity of 7,50,000 gal per day

In recent years the fluidization technique has been applied to the synthesis of liquid fuels by the Fischer-Tropsch synthesis In this synthesis pure carbon monoxide and

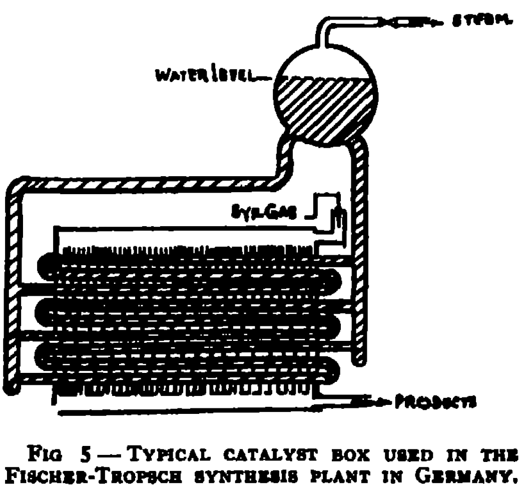

FIG 5 — TYPICAL CATALYST BOX USED IN THE FISCHER-TROPSCH SYNTHESIS PLANT IN GERMANY.

hydrogen in the ratio of one to two are passed over a suitable catalyst kept at a temperature of about 230°C when the synthesis of liquid hydrocarbon takes place Since the reaction is an exothermic one, unless suitable provision is made to remove the heat liberated, the reaction products will decompose into methane, carbon monoxide and other less useful products One of the chemical engineering problems involved in the commercial exploitation of the reaction for the synthesis of liquid fuels is to devise a suitable method of dissipating the heat evolved during the reaction The Germans solved this problem by passing the synthesis gas through a series of boxes packed with a suitable catalyst, in which there was arrangement for circulating water through coils. Fig 5 shows a typical catalyst box used in Germany. By varying the amount of water in circulation through the coils the reaction was controlled One catalyst box alone weighed about 47 tons when empty and each box contained about 3 tons of catalyst In a plant producing 1,80,000 gal of liquid fuel per day there were some 120 similar catalyst boxes Despite such elaborate set-up occupying a large area, the conversion of synthesis gas to liquid fuel was only 30 to 40 per cent The motor spirit that was obtained was also of a very poor quality having an octane number of only 40

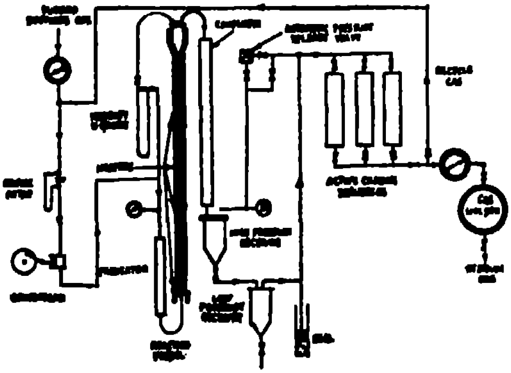

FIG 6 — FLOW-SHEET OF THE EXPERIMENTAL UNIT SET UP AT THE FUEL RESEARCH STATION, GREENWICH, ENGLAND, FOR FISCHER-TROPSCH SYNTHESIS.

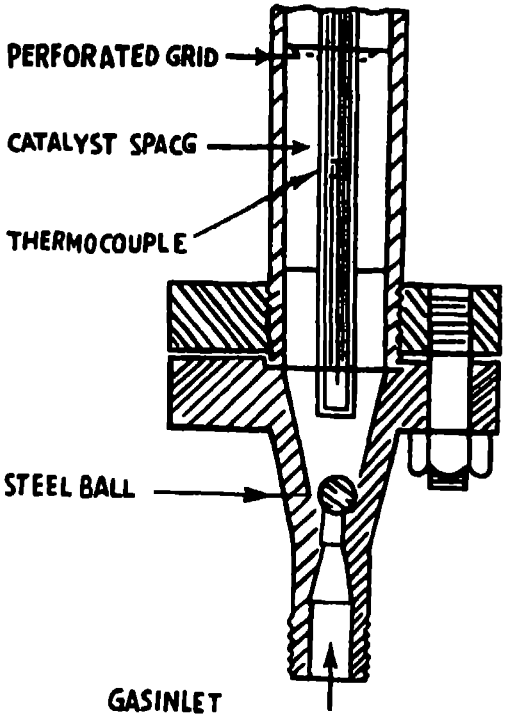

FIG 7 — THE LOWER PORTION OF THE REACTION TUBE IN THE EXPERIMENTAL FISCHER-TROPSCH SYNTHESIS UNIT AT THE FUEL RESEARCH STATION, GREENWICH ENGLAND

In recent years the Americans have applied the fluidization technique to the Fischer-Tropsch synthesis. In the process they have developed the catalyst is kept in a fluidized state by the synthesis gas Unfortunately no detailed account of the plants is available. According to the little information available, the Kellogg "Synthol" process[4,5] is capable of producing 75 ASTM octane number (83 Research) gasoline for about 5 cents per gal, using natural gas at 5 cents per 1,000 cu ft and figuring plant depreciation at 10 per cent per year According to the Kellogg claims, by keeping an iron catalyst in fluidized state the major product which can be leaded to 80 ASTM octane number by addition of tetraethyl-lead can be obtained

Hall[6] at the Fuel Research Station, Greenwich, has been using the fluidization technique in his experiments on Fischer-Tropsch synthesis The experimental set-up that he adopted is shown in Fig. 6 The reaction vessel employed consisted of a 3 05 metre length steel tube, 2 5 cm internal dia, fitted with a conical gas inlet at the lower end and with a 30 5 by 7 6 cm disengaging column at the top to allow entrained catalyst to separate from the gas

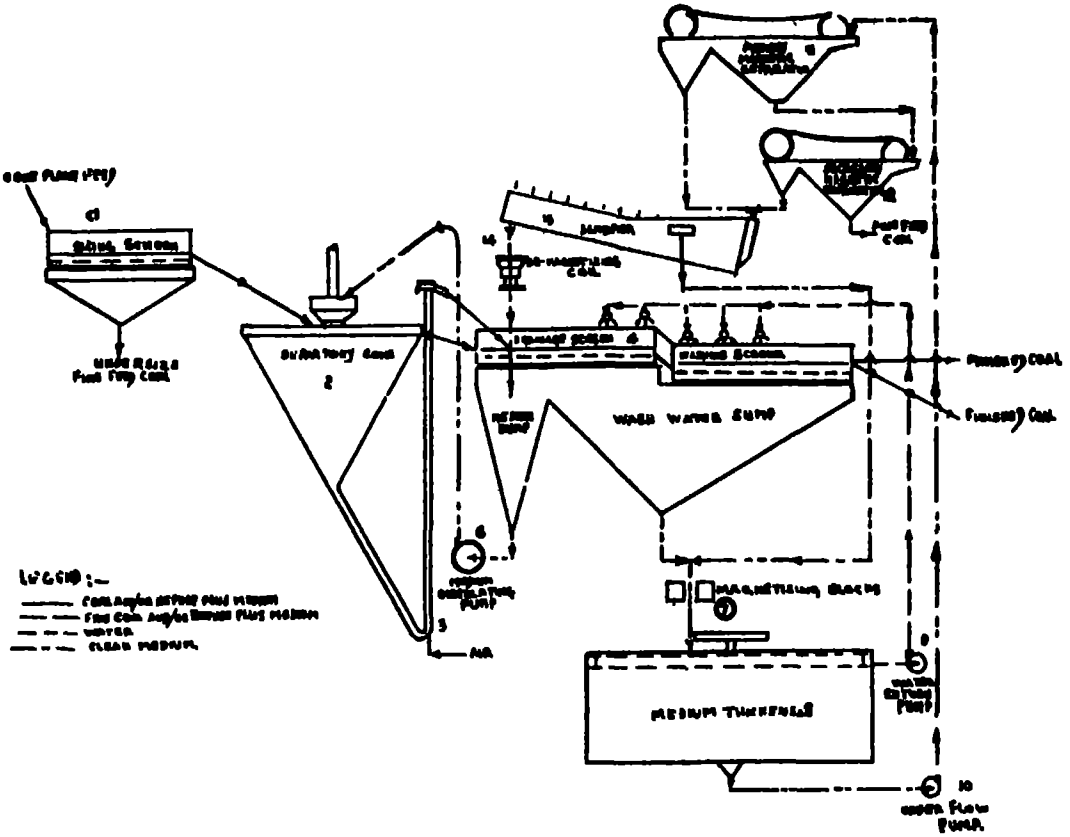

FIG 8 — FLOW-SHEET OF THE HEAVY MEDIA SEPARATION UNIT WHICH IS BEING INSTALLED AT THE CENTRAL RESEARCH LABORATORIES, HYDERABAD (DECCAN)

stream. A central tube, 0·8 cm external dia., served as a thermocouple pocket and as a support for grids cut from steel gauge (4 mesh/cm) which were made slightly convex to the gas flow and spaced at 5 cm interval up the tube

The reaction tube and the disengaging column were heated electrically, no special heat-dissipating means (aluminium block or liquid jacket) being employed. The lower portion of the reaction tube is shown in Fig 7.

Another recent application of fluidization technique to exothermic reaction that may be mentioned is the oxidation of naphthalene to phthalic anhydride[7]. Naphthalene is oxidized by air at 340° to 400°C. in the presence of vanadium peroxide as catalyst There is a considerable evolution of heat during the reaction — 10,000 B.Th U /lb of naphthalene converted — and the advantage that fluidization offers in the dissipation of heat is one of its main advantages. The vaporized naphthalene is mixed with air and flows into a chamber, 5′ dia. by 30′ high, where it fluidizes the catalyst bed and is converted to phthalic anhydride. In this case the catalyst is not inactivated by any of the reaction products and so no regenerator is required The product gases, after leaving the dense catalyst phase, pass through a settling zone and cyclone separators to remove entrained catalyst and then to condensers which liquefy the phthalic anhydride. The through-put is 400 lb. of naphthalene per hour and the product is 99 per cent pure which is better than 96 to 98 per cent purity obtained in the conventional processes.

The fluidization technique has been applied to the washing of coal on the sink and float principle in the heavy media separation

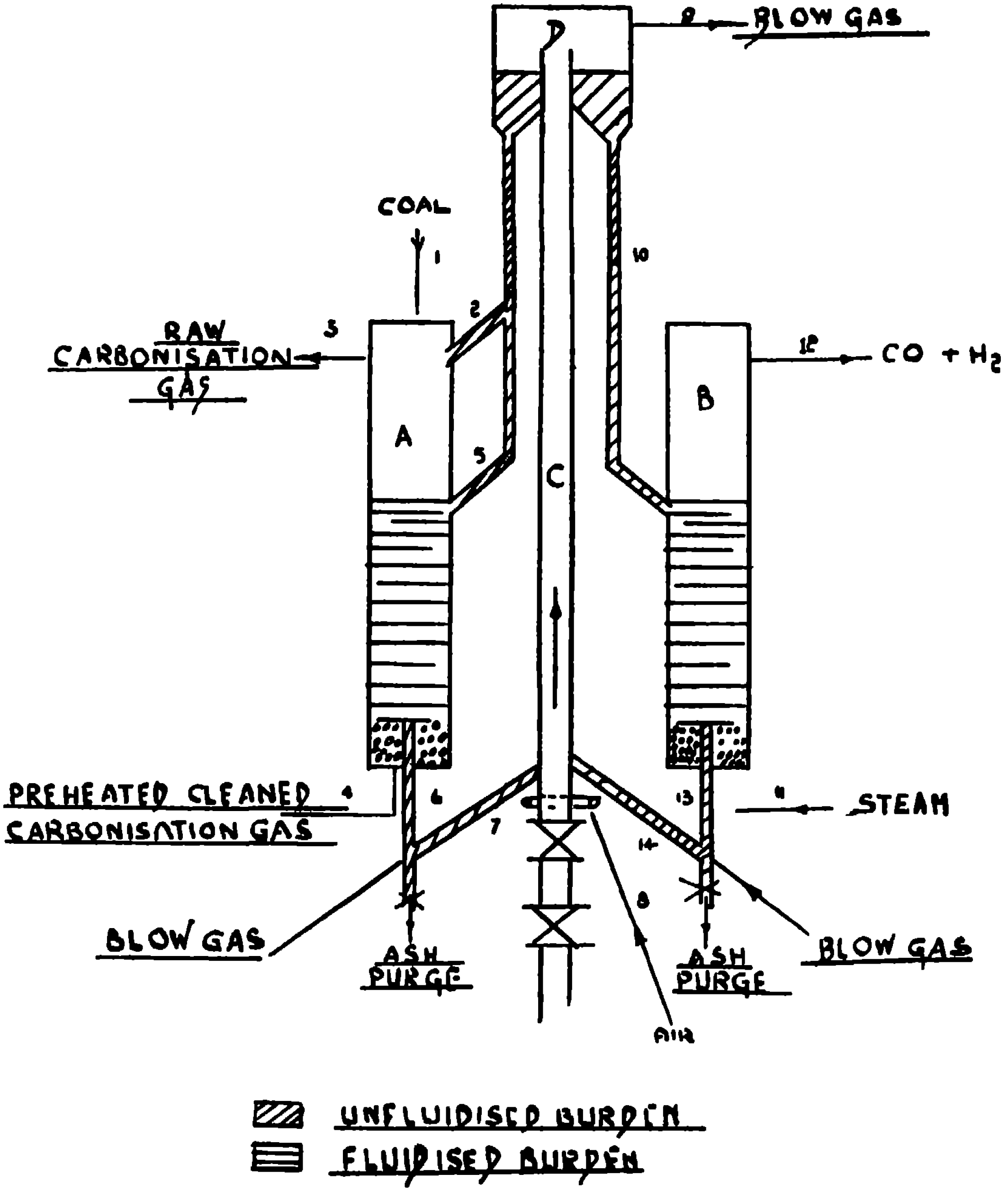

Fig 9 — Flow sheet of a semi technical moving burden water gas plant

unit developed by the *American Cynamide Corporation*[8] The installation of an experimental plant of 500 lb capacity is being completed at the Central Laboratories Hyderabad (Dn) The flow diagram of the unit is shown in Fig 8 In the unit finely ground, low cost magnetite (sp gr 5 0 to 5 2) is fluidized by a stream of water furnishing a medium that very closely duplicates a true heavy liquid as regards fluidity and stability in a range of gravities from 1 25 to 2 50 Coal of size coarser than $\frac{1}{8}''$ is fed from sizing screen (1) to the separatory cone (2) through which is flowing the fluidized magnetite The clean coal separates out at the top and is removed to the draining screen (4) where it is separated from the medium The impurities of coal sink to the bottom of the medium in the separatory cone entrained by a stream of air and lifted up to the draining screen where the medium is recovered from the impurities In the recovery and control of concentration of the medium advantage is taken of the magnetic property of magnetite

In the heavy media separation unit coals of as low a specific gravity as 1 25 and as high a specific gravity as 2 5 can efficiently be treated

The fluidization technique has been applied in recent years to a number of processes Dr Garside at the University of Leeds has developed a novel method of purifying town s gas from sulphur Prof Mertens at the University of Louvain Belgium has developed an interesting method of converting sulphur dioxide to sulphur trioxide It is not possible in this paper to go into details about all these processes However it may be interesting to describe briefly the pilot plant developed by the *I C I* for carbonization and gasification of non caking coals[11] to indicate the recent trends in the development of fluidization technique The plant is represented diagrammatically in Fig 9 Coal as particles of 1 0 mm dia or less according to design is carbonized by direct contact with hot particles in the gas space of the vessel A by injecting it through (1) into a regulated stream of hot burden (coke and ash at 1 100 C) flowing from the hopper D through valve (2) the bed in this carbonization vessel is fluidized by the carbonization gas produced (3) part of which is recycled through (4) after cooling cleaning and reheating The bed level is automatically maintained by a governor tube (5) from the hopper The burden containing freshly carbonized coal is transferred by a downcomer (6) and a stream of hot nitrogen or blow gas (7) to the combustion tube C in which it is partially burnt to raise its temperature to 1 100 C while being entrained into the hopper D by air (8) preheated to 500°C the blow gas produced is drawn off at (9) Water gas production takes place in vessel B hot burden from D flowing into B *via* the governor tube (10) which regulates the level of the bed through which steam is blown (11) the water gas and undecomposed steam leaving by (12) As on the carbonization side the burden is taken from B by the downcomer (13) and an inert gas stream (14) to the combustion stage where it combines with the carbonization burden circulation The dimensions of the vessel B the steam rate and the rate of circulation of the burden are such that the gas contact time is adequate (a few seconds) for economic steam decomposition and that the steam rate will boil the bed and achieve good gas solid distribution The process as a whole therefore consists of two continuous circulations of burden for the carbonization and steaming stages with a common combustion stage in which the heat required for the endothermic processes is restored by partial combustion of the burden

It will be seen from the diagram (Fig 9) that there are many problems to be solved before full scale process plant can be designed — problems in carbonization conditions dust and tar removal control of heat of reaction in blow vessel to prevent slugging control of flow of powders design of heat exchangers etc The *I C I* have studied this process on a laboratory scale and on a semi technical scale Many of the snags in the detailed operating conditions have been overcome and progress has been sufficiently satisfactory to justify a small pilot plant This will have a capacity of 500 cu m /hr of water gas (about 300 c f m)

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Manufacture of Zinc Oxide from Zinc Sulphide Flotation Concentrates—Literature Report No 11

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National Metallurgical Laboratory C S I R Jamshedpur

THE most important use of zinc oxide is in the pigment industry although it has various other uses also such as in the ceramic and the rubber industries For white paints pure zinc oxide is used but for certain other grades leaded zinc oxide is used The physical and the chemical characteristics of the oxide particles are of importance e g for paints acicular or needle shaped particles (anisotropic) are desirable for giving superior weathering properties For use in the rubber industry uniformly sized round (isotropic) particles measuring about 0 22 microns are preferred This indicates that the process by which the oxide is manufactured has a considerable influence over the quality of the product and consequently its suitability for various uses

In this article the various methods of manufacture of zinc oxide as practised in other countries are briefly described

In India zinc oxide is manufactured from imported spelter This is an indirect method of producing the oxide and is naturally very costly India has been adopting this process for obvious reasons because zinc ore was not produced till now in this country The *Metal Corporation of India Ltd* which operates a lead zinc mine at Udaipur are shortly expected to bring their ore-dressing plant into production stage when about 12 15 tons of zinc sulphide concentrates will be produced daily Till a reduction plant is put up in India to utilize these concentrates for production of spelter perhaps the best possible outlet for these flotation concentrates will be for the manufacture of zinc oxide This will also eliminate imports of spelter into India for this purpose

Comparative merits and demerits of various processes have been discussed and their suitability for adoption in India is suggested

Manufacture

The three processes employed for the manufacture of zinc oxide are

1 The Direct Process which produces the oxide direct from the sulphide ore or sulphide concentrates This is achieved by reducing zinc sulphide by means of carbonaceous fuel and immediately burning the evolved zinc vapour to oxide This process is also known as the American Process

2 The alternate method of producing pigment zinc oxide is the Indirect Process also known as the French Process The raw material is metallic zinc which is volatilized and burnt to oxide

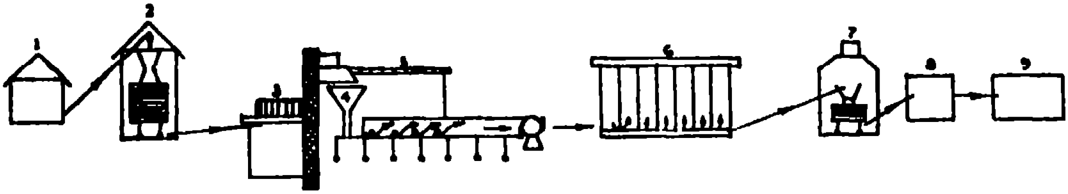
3 The Wet Process precipitates the carbonate or hydrate from zinc bearing liquors and then calcines the precipitate

1 *Direct Process* — Following are the different methods adopted at various places for the manufacture of oxide from ore or sulphide concentrates

(a) The Wetherill grate furnace method
(b) The travelling grate furnace method
(c) The Waelz process
(d) The electrothermic process
(e) The electric process
(f) The flash fume process

(a) Wetherill Furnace Method[1,2]— Two types of furnaces called the Eastern and the Western Wetherill furnaces are used The essential difference between the two types is that in the Eastern type zinc fumes from various furnaces are led to a system of combustion chambers for oxidation whereas in the other type of furnace the fumes are conducted through a common flue to a combustion chamber

Ore and anthracite coal or any other small sized smokeless fuel are thoroughly mixed with water The charge is spread over the grate after the furnace has been properly lighted Zinc vapour produced is burnt to oxide in combustion chambers.



1 Concentrated unloading station 2 Roaster 3 Mixing plant 4 Charging bin 5 Furnace block 6 Bag house 7 Refinery 8 Packing house 9 Warehouse

FIG 1 — FLOW SHEET FOR MANUFACTURE OF ZINC OXIDE BY WESTERN WETHERILL PROCESS (*American Zinc Oxide Co*)

The oxide along with gases is passed through bag filters where the zinc oxide is collected

Flow sheet for this method is given in Fig 1

(b) Travelling grate Method[1] — Ore and coal are used in the form of briquettes Ore briquette is composed of 80 per cent finely divided ore plus 20 per cent fine sized anthracite (coal briquette is prepared from low grade fine anthracite) Sulphite liquor is used as binder for coal briquetting as well as for ore briquetting

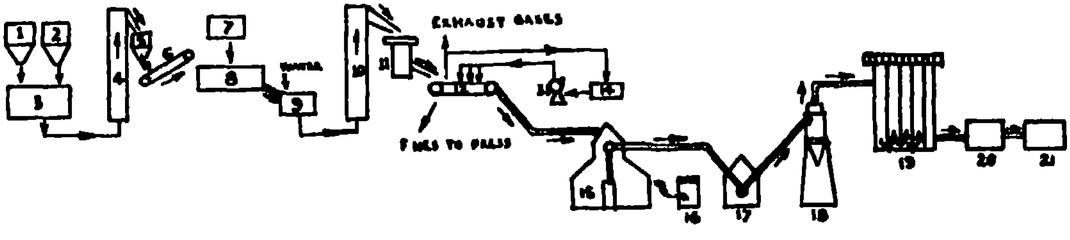
The travelling grate in its forward journey first picks up coal briquettes which start burning as the grate enters ignition zone A layer of ore briquettes is then deposited over the incandescent coal bed and the grate enters the reduction zone under a forced draft Zinc fumes produced are passed on to a combustion chamber and oxide is formed

A flow sheet of the process is given in Fig 2

(c) Waelz Process[13] — Ore is subjected to a preliminary roasting if the sulphur content is high (more than 10 per cent) Fine sized ore (75 per cent) is thoroughly mixed with coke dust (25 per cent) and water This charge is fed into an inclined rotary kiln which is heated by pulverized charcoal and is under an induced draft Zinc fumes produced are passed through the oxidizing chamber and then to bag filters

(d) Electrothermic Process[14] — Ore or sulphide concentrate is first roasted whereby most of the sulphur is eliminated as SO_2 The roasted concentrate is then thoroughly mixed with a flux fuel and water and sintered at about 1 600°C The sintered cake is crushed screened and combined with carefully sized coke and preheated to about 750°C The preheated material is then charged into an electric furnace in which the charge itself serves as the resistance in developing temperature Air is forced inside the furnace which oxidizes the zinc fumes Oxide is then passed through a cyclone separator to the bag house

The electrothermic process is adopted by *St Joseph Lead Co* U S A with an ore of the composition Zn 57 per cent Pb 0 6 per cent Fe 6 6 per cent Cd 0 1 per cent SiO_2 1 per cent CaO and MgO 0 7 per cent The typical example of the final product is ZnO 99 4 per cent PbO 0 01 to 0 5 per cent CdO



1 Coal bin 2 Ore bin 3 Weighing hopper 4 Elevator 5 Mixed storage bin 6 Conveyer 7 Binder 8 Paddle mixer 9 Pan mixer 10 Elevator 11 Large briquetting press 12 Briquette pan dryer 13 Fan 14 Fire box 15 Oxide furnace 16 Blow house 17 Fan house 18 Cyclone separator 19 Bag house 20 Packing house 21 Oxide storage

FIG 2 — FLOW SHEET FOR TRAVELLING-GRATE FURNACE METHOD

0·002 per cent, Fe_2O_3 0·002 per cent, total S as SO_3 0 06 per cent

Flow-sheet of the process is given in Fig 3

(e) Electric Process[5] — Zinc ore or concentrate is roasted with free access of air in an electric furnace whose carbon sides serve as electrodes. A layer of powdered charcoal connects the electrodes before starting Air is forced in from the top of the furnace. Zinc oxide formed is passed through cyclone separator and bag filters

(f) Flash-fume Process[6] — Zinc sulphide concentrate, after being completely dried, is dispersed into four or more furnaces by compressed air nozzles and ignition is accomplished by natural gas burners Sulphur in the concentrate burns like powdered coal or atomized oil The collected zinc oxide is sent for heat treatment to improve its physical and chemical properties It is then discharged into a hammer mill to break any agglomerated particles formed during heat treatment The oxide then passes on to a blending plant

If leaded zinc oxide is desired, a calculated amount of basic lead sulphate is added to zinc oxide

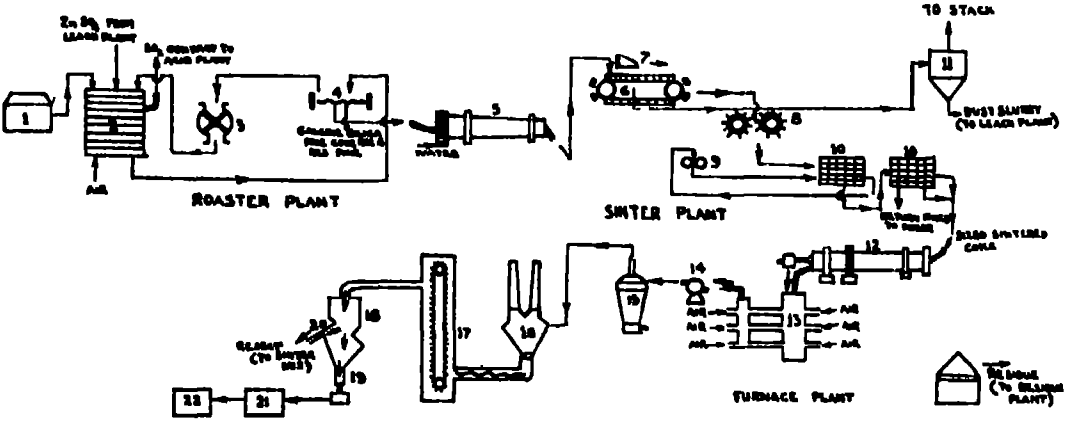
2. *Indirect Process*[7,8] — Oxidation of zinc in crucibles each with its own furnace gives good quality oxide if very pure zinc is used Zinc is vaporized in a reducing atmosphere at approximately 1,200°C and then passed to the combustion chamber when a forced draft is maintained keeping the temperature at 1,100°C The gases and oxide are then passed to another chamber where temperature is kept at 850°C. They are passed to the next chamber with gradually decreasing temperature until they reach the bag filters

The oxide is refined by reheating If cadmium is present, it is removed by preheating in a reducing temperature

3 *Wet Process*[9] — Zinc ores, preferably roasted, are heated with an excess of sulphurous acid solution with the formation of soluble zinc bisulphite which, when heated, separates out as insoluble zinc sulphite The sulphite is washed, redissolved in excess of sulphurous acid and the liquor is treated with milk of lime, which precipitates zinc hydroxide The latter is digested with ammonia to form ammonium zincate, from which zinc oxide is obtained by calcination Ammonia is regenerated

Comparative Merits & Demerits of Different Methods

Among the three grate-type furnaces, the travelling grate is more advantageous to operate than the others Rate of combustion of the charge has a great influence over certain physical properties of pigment A free-burning open charge, rapidly worked, produces material different from that produced by a charge that is dense and slow-working The use of briquetted charge in



1 Ore storage 2 Roaster 3 Hammer mill 4 Screen 5 Mixer 6 Sinter machine 7. Ignition furnace. 8 Tooth-roll crusher 9 Smooth-roll crusher 10 Trommels. 11 Cottrell dust precipitator 12 Preheater. 13 Electric furnace 14 Fan. 15 Agglomerate trap 16 Filler bags. 17 Bag house. 18 Blend bin 19 Packer 20 Screen. 21 Storage bins.

FIG 3 — FLOW-SHEET FOR ELECTROTHERMIC PROCESS (*St. Joseph Lead Co*).

the travelling-grate method helps to attain the above working conditions.

In the Waelz process, the necessity for pre-roasting is eliminated as ferrites, ferrates, sweet roast and sulphate roast are all easily reduced in the kiln As the reducing and oxidizing zones are superimposed over the whole length of the reduction zone, the amount of heat consumed by chemical reactions is balanced. A lesser amount of fuel is needed as the burning of zinc vapours gives back a corresponding quantity of energy.

The treatment of slags from lead-smelting blast furnaces for extraction of these zinc contents and recovery as oxidized fume is done on a large scale by this process at the *East Helena Slag-treating Plant of the Anaconda Copper Mining Co* and elsewhere Electrolytic back-leach residues need not be dried, for the process will treat slimes running 40 per cent moisture without preliminary drying Fuel consumption is also low and almost any sort of coke can be used.

St Joseph Lead Co of Josephtown is using the electrothermic process. The process requires elaborate equipment and hence is costly.

The success of the electric process depends on the availability of cheap power

Flash fuming of sulphide ores is the latest development towards the production of pure zinc oxide for use as a pigment The process is simple and there is a great increase in furnace capacity and perfect control over the desulphurization But there is the disadvantage of a large amount of dusting The method is in the experimental stage and its use on an industrial scale has not yet been adopted

Purification of Zinc Oxide[9] — The principal impurities in zinc oxide are the oxides of Bi, Sb, Cd, Se, Te and basic lead sulphate. Zinc oxide can be purified by digesting it under slightly reduced pressure with 4-N ammonium carbonate at ordinary temperature All the zinc oxide is dissolved together with Cd and a small quantity of Ag, leaving a residue of basic lead carbonate and other impurities The filtered solution is passed through a cylinder containing scrap zinc to remove Cd and Ag and then distilled with live steam, whereby zinc is deposited as carbonate which can be converted into oxide by heating at 400°C.

Zinc oxide condenses at 1,370°C. whereas other volatile oxide impurities condense at 1,060°C By careful control, this difference in condensation temperatures can be utilized for the separation of zinc oxide from its impurities.

Uses of Zinc Oxide[9, 10] — Various uses are in

1 Pigment industry
2. Rubber industry
3 Ceramic industry
    (a) Glazes
    (b) Enamel
    (c) Glasses
4. Cosmetics and medicinal purposes.

For white pigment, pure oxide is essential , sometimes leaded zinc oxide[9] is also used. The most common blends for the latter type of pigments are (i) 35 parts sublimed white lead with 65 parts zinc oxide, and (ii) 50 parts of sublimed white lead plus 50 parts of zinc oxide.

In rubber[11], the oxide acts as an accelerator, activator and imparts high strength to the finished product As a reinforcing agent, it is second only to carbon blocks. Where high tensile and tear resistance are required and colour is also important, it holds the field It is used as a compounding ingredient for all synthetic rubber such as Butadiene-styrene rubber, Butyl rubber, Neoprene, Thiokol, etc , and serves as the curing agent Best results are normally obtained with 5 per cent based on the rubber, but in tyre treads and other such carbon black compounds, 8 or 10 per cent is often used.

In the ceramic industry[12], it is commonly used in glazes and in many optical glasses to reduce their tendency to crystallize on cooling In glazes, it acts as a fluxing agent, reduces the expansion, prevents crazing and increases the gloss and improves the whiteness and opacity.

Zinc oxide in sheet-iron enamels[13] increases fusibility, gives a superior gloss, lowers frit solubility and increases acid resistance.

Specifications for Zinc Oxide for Pigments[14] — 1 Zinc Oxide

Composition & Properties

(a) Dry Pigment — The pigment shall be zinc oxide of either the American process type or the French process type to conform to the following requirements

	American process type max %	American process type min %	French process type max %	French process type min %
Zinc oxide	—	98	—	99
Total sulphur	0 2	—	0 1	—
Moisture and other volatile matter	0 5	—	0 5	—
Total impurities including moisture and other volatile matter	2 0	—	1 0	—
Coarse particles (total residue retained on a No 325 44 micron sieve)	1 0	—	1 0	—

(b) **Paste in Oil** — The paste shall be made by thoroughly grinding the specified pigment with linseed oil As received it shall not be caked in the container and shall break up readily in oil to form a smooth paint of brushing consistency The paste shall conform to the following requirements

Pigment per cent	80 16
Linseed oil per cent	14 20
Moisture and other volatile matter per cent	0 5 max
Coarse particles and skin (total residue retained on a No 325 sieve) per cent of dry pigment	1 5 max

(c) In the event that either an acicular or a nodular type of zinc oxide is desired the particle shape shall be determined by examining or photographing microscopic mounts (1000X or more) of the samples

2 Leaded Zinc Oxide

Composition & Properties

(a) **Dry Pigment** — The pigment shall consist of zinc oxide and normal or basic lead sulphate and shall conform to the following requirements

	35% leaded
Zinc oxide per cent	62 67
Matter soluble in water per cent	1 0 max
Moisture and other volatile matter per cent	0 5 max
Total impurities including moisture and other volatile matter per cent	2 0
Normal or basic lead sulphate	remainder
Coarse particles (total residue retained on a No 325 sieve) per cent	1 0 max

(b) **Paste in Oil** — The paste shall be a dispersion of the specified pigment in linseed oil As received it shall not be caked in the container and shall break up readily in oil to form a smooth paint of brushing consistency It shall mix readily in all proportion without curding with linseed oil turpentine or volatile petroleum spirits or any mixture of these substances The paste shall conform to the following requirements

Pigment per cent	81 87
Linseed oil per cent	13 19
Moisture and other volatile matter per cent	0 5 max
Coarse particles of skins (total residue retained on a No 325 sieve) per cent of dry pigment	1 5 max

Specification for Zinc Oxide from Messrs Paint Federation Calcutta

Description — The material shall consist of zinc oxide in the form of dry powder

Moisture — Maximum 0 5 per cent

Composition — After drying at 98° to 102°C it shall contain not less than 99 5 per cent of zinc oxide The percentage of lead expressed as PbO shall not exceed 0 2

Coarse Particles — It shall not contain more than 0 1 per cent of coarse particles when tested in the manner described under the general clause

Oil Absorption — The oil absorption of the material shall not be less than 12 or more than 20 when determined in the manner described under the general clause

Colour & Reducing Power — In whiteness and reducing power the material shall be equal to the agreed sample The test for reducing power shall be carried out in the manner described under the general clause

The zinc concentrates that may be available from Zawar Mines is expected to have the following approximate analysis

	%
Zn	55 60
Pb	up to 5
Cd	0 5-0 7

Conclusion

The electrothermic process produces high grade of zinc oxide but the initial cost of installation of the plant is high so also is the operating cost

Much is not known either about the flash-fume process or the direct electric process

Out of the remaining the Wetherill and the Waelz processes are extensively used in the United States With the Wetherill furnace it is necessary to counteract the tendency of the blast to break through the charge making blow holes and craters This requires constant attention These disadvantages were overcome by the *New*

Jersey Zinc Co by briquetting the charge made up of ore and coal This opened the travelling-grate method by which the output per furnace increased, resulting in lower operating and investment cost per pound of product The quality of product is also under better control

The Waelz process is simple and relatively cheap for treating low grade ores and for recovery of zinc from lead smelting blast furnaces

The process suitable for zinc sulphide concentrates appears to be the improved Wetherill process employing the travelling grate.

Acknowledgement

The authors wish to express their thanks to the Director, National Metallurgical Laboratory, for permission to publish this report.

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Nuffield Foundation Travelling Fellowships for India

THE NUFFIELD FOUNDATION, WITH THE object of advancing the interests of India and for further strengthening the academic ties between India and the United Kingdom, has decided to make available to India five Travelling Fellowships from 1951-52 An Advisory Committee consisting of Shri Gaganvihari L Mehta (*Chairman*), Shri S Varadachariar, Dr C. V Raman and Shri J J Ghandy has been appointed to advise the Foundation on the administration of the scheme The Fellowships will be awarded by the Trustees of the Foundation on the recommendation of this Advisory Committee

It has been decided to award Fellowships during 1951-52 in the following subjects

Two Fellowships in *Medical Sciences*, preference being given to candidates wishing to study (1) Physiology or Bacteriology, and (2) Industrial Medicine or Public Health One Fellowship in *Engineering*, preference being given to candidates wishing to study Electrical Engineering (Generation or Distribution) One Fellowship in *Natural Sciences*, preference being given to candidates wishing to study Plant Genetics or Soil Science, and one Fellowship in *Social Sciences*, preference being given to candidates wishing to study Industrial Relations or Personnel Management, and Agricultural Economics

The purpose of the Fellowships is to enable Indian graduates of outstanding ability to gain experience and training in the U.K in their chosen fields, and to make contacts with scholars working in those fields, with a view to the Fellows equipping themselves to take up senior posts in research and teaching in India

The Fellowships are intended for men or women of first-rate intellectual and personal qualities, who have already shown unusual capacity to advance knowledge and teaching in one of the fields concerned Candidates must be Indian nationals, normally between the ages of 25 to 40 years, and must be university graduates holding, preferably, a Master's or a Doctor's degree and having subsequently had a year or more of teaching or research experience on the staff of a university or comparable institution

A Fellowship will normally be tenable for one year, but in exceptional cases may be extended by a few months, the tolal value of the award being (exclusive of travelling expenses) £770 to £890 a year

Applications for Fellowships to begin in 1951 should be submitted not later than the 31st March 1951 to the Secretary, Nuffield Foundation Advisory Committee in India, C/o Planning Commission, Government House, New Delhi, from whom copies of the form of application may be obtained.

REVIEWS

Organic Chemistry, by Paul Karrer, translated by A J Mee (Elsevier Publishing Co , Amsterdam, London, New York & Brussels), 1950, Fourth English Edition, pp. 983 Price 57*s* 6*d*

KARRER'S " ORGANIC CHEMISTRY ", THE first English edition of which was published in 1938, has now established itself throughout the world as one of the standard textbooks on the subject The first German edition (*Lehrbuch der Organischen Chemie*) appeared in 1928, and the English translation made in 1938 was based on the fifth German edition In view of the fact that Karrer is among the greatest organic chemists of all time, this is a safe choice of a text-book giving a clear, comprehensive and balanced account of a vast and rapidly expanding science Considering the scope and size of the book, it makes very pleasant reading from end to end Karrer's approach is essentially classical and his treatment lays emphasis on synthetic reactions, experimental methods and the steps by which the structures of naturally occurring compounds are determined Both synthetic and natural substances of biological interest receive special attention In revising the third edition, much of the material has been brought up to date Some of the additions are streptomycin, organic silicon compounds such as the silicones, and organic compounds containing carbon and nitrogen isotopes The chapters or sections dealing with microanalysis, sex hormones, vitamins and alkaloids have been largely rewritten The chemistry of chloromycetin (chloramphenicol) was apparently not known in time for inclusion

Deficiencies in the book are mainly in the sense that for a full course in organic chemistry it must be supplemented by books on the theory of organic chemistry, the technique of organic chemistry and organic chemical technology or, at least, by Bernthsen and Sudborough's text-book which covers a wider range of topics treated in a systematic manner Karrer's classification according to functional groups and ring systems is generally satisfactory, but leads to such anomalies as the widely separated occurrence of sulphanilamide, sulphathiazole and sulphapyridine There are no references to the original literature There are a few references to books, sometimes not to the latest book on the subject, e g for diazo compounds, Hantzsch and Reddelien's classical book is rightly cited, but Saunders, 1936 and 1949, might well have been added The importance of the sulphanilamides would have been demonstrated very simply if a reference to Northey's book of 660 pages had been made

Although it is obvious that a text book cannot be an encyclopaedia and omissions are inevitable there are some which need to be noticed, e g preparation of succinic acid by catalytic reduction of maleic acid , chromatography and in particular the separation and identification of amino acids by paper partition chromatography , lauryl al cohol, sodium lauryl sulphate and other wetting agents and detergents , the oxidation of ethylene to ethylene oxide and the technical importance of the latter , 9 10-dimethyl-1 2-benzanthracene and 20-methylcholanthrene as most potent carcinogens , Bardhan's synthesis of phenanthrenes , diaminodiphenylsulphone , trifluoromethylbenzene and its derivatives , the Raschig process for phenol , technical production of phthalic acid from *o*-xylene, of benzoic acid by decarboxylation of phthalic acid and of benzoyl chloride from benzotrichloride , esters of phthalic acid and their uses as plasticizers , the use of phthalic anhydride in the manufacture of alkyd resins , zinc chloride double salts of diazonium salts (the common type of stabilized diazonium salts) , azoic coupling components other than Naphtol AS , formation of complexes by trinitrobenzene , technical preparation of *m*-nitrotoluene by fractionation of the nitrotoluenes , 4- and 5-aminosalicylic acid , the technical importance of terephthalic acid , selenium dioxide oxidation of *o*-hydroxychalkones to flavones , copper chromite, Raney nickel and lithium aluminium hydride reductions , preparation of thionaphthene from thioindoxyl (which is superior to the method mentioned), cyanine dyes other (and far more important) than the quinoline derivatives , the Pfitzinger, Willgerodt and various other important reactions The title of chapter 39 (" Quinone Dyes with Closed Rings ") is inappropriate Erroneous structures are given for diazotized sulphanilic acid and Indanthrene Bordeaux B A new structure is suggested for Hydron Blue with no reference to experimental data Algol Yellow 3G is mentioned as Algol Yellow G

K V.

Progressive Mathematics, by P Clyne, (Chapman & Hall Ltd , London), 1950, pp xii + 270 Price 15*s* net

THE AUTHOR, IN HIS PREFACE, HAS EXplained that the object of his book is to develop the mathematics from about the School Certificate stage to Higher National Certificate level, as a serial story, sweeping into appendices all interesting mathematical results which do not fit in the picture We have the authority of the foreword that the method of the text has worked successfully with many students of our " Responsible Lecturer ". The reader is perhaps to be congratulated on his being carried a long way in a short space, though the process may be rather risky The long way starts from zeroes, infinites and their quotients, determinate and indeterminate, and labours through differentiation, maxima and minima, infinite series, integration, conic sections, vectors, Fourier series and differential equations. To the appendices are relegated equations, triangle mensuration, permutation and combination, the binomial theorem, important curves like the catenary, the cycloid and the cardioide, polar co-ordinates and determinants

The short space in which the author has woven such a variety of topics could have been made even shorter with a little restraint of diction and doubtful humour What is the use of such a definition as " Successive points are those which are closer together than any specified distance, yet both on a curve " (p 9) ?

The author's humour may be tolerated in a serious text-book if it does not go too far into fields of irrelevancy and coarseness and does not waste the reader's time. Such terms of expression as " integrating the brute " and ' formula-fiends " serve no purpose The dialogues between the student and the teacher, though sometimes spicy, become of doubtful significance when they are enigmatic (p 14)

The reviewer is constrained to remark that there are certain definitely wrong teachings in the text One wonders how intelligent students with adult minds can readily swallow the different-sized zeroes (p 21), the proof of the indeterminacy of 1^{∞} (p. 5), the proof of the area of the circle based on

$$\underset{\theta \to 0}{\mathrm{Lt}} \frac{\sin \theta}{\theta}$$

which is itself proved with the help of the formula πr^2 (pp 41, 42), the mode of gradual distortion of a circle into an ellipse, a parabola and a hyperbola (p 117) and the conditions for convergence which are half-truths, since convergence and finite oscillations are not clearly distinguished (p 71) Though the author does not wish himself to be regarded as a creature of tradition, he has thought fit innocently to repeat such traditional mistaken notions as (1) the lesser of the turning value must be the minimum (p 60) and (2) a parabola is obtained by taking a section plane parallel to one of the generating lines (p 117).

In spite of all the erratic and unconventional modes of presentation and misplaced rhetoric, there is a certain sincerity of exposition underlying *Progressive Mathematics* which gives the book its real value The chapters on integration and Fourier series are particularly well done There are numerous worked examples with applications to engineering and there is a good collection of exercises at the end of each chapter and answers are also provided for them Any student carefully plodding through the book will get a useful mathematical foundation which will stand him in good stead in various practical applications of mathematics

The printing and get-up of the book are just what may be expected of the well-known publishers, Chapman & Hall The latter part of the book contains a few printing mistakes which may be rectified in a second edition.

A A KRISHNASWAMI AYYANGAR

The Vanderbilt Rubber Handbook, edited by S S Rogers (R T Vanderbilt Co , New York), 1948, pp 719

THIS IMPORTANT BOOK, NOW IN ITS NINTH edition, is based on the formulations for the compounding of rubber products with the compounding materials marketed by the *Vanderbilt Co* True to its tradition, the book admirably maintains the rôle of initiating "new men coming to the rubber industry in the fundamentals of compounding and to provide the more experienced technologists with a fund of reference material in a handy form"

The book is divided into five sections The articles in these sections are written by specialists and bear their stamp of authority for accuracy Section I, covering the field of compounding, both of dry rubber and latex, has chapters on types of polymers both synthetic and natural and their reclaims, rôle of fillers, accelerators, antioxidants, vulcanizing agents, processing aids and the principal processing operations involved in general rubber goods manufacture Section II gives a tabular summary of the properties and uses of Vanderbilt compounding materials Under Section III are given test methods and equipment covering essentially the methods which have been developed by the various rubber manufacturing concerns to compare and evaluate the products and have the approval of the trade or of the American Society for Testing Materials It is rightly emphasized that no laboratory tests can quantitatively predict the service behaviour of the product but are merely a check on the properties of a component which within the experience of the technologist has given a satisfactory product This section could probably have been made more complete by inclusion of methods for the chemical analysis of rubber products (A S T M, D 297-43 T)

Section IV gives general articles on subjects like yarns and fabrics, textile testing, rubber derivatives, application of X-ray and electron microscope methods and induction heating in the field of rubber, etc The treatment of these articles is elementary, but each one is enriched with an excellent bibliography to guide those interested in further information

In Section V are assembled tables and charts on the statistics of rubber, both natural and synthetic, their consumption, price movements over a number of years, specific gravity of rubber compounding ingredients, gravity and weight charts useful in designing a rubber compound steam pressure-temperature charts and other valuable conversion data needed by a rubber technologist

The book is a mine of information and the publishers, who have been issuing "Vanderbilt News" and other laboratory reports on rubber materials and processing, have done a signal service in issuing them in the form of the above book Rubber industry is known for its "bugs" and this book may help to locate these

M R VERMA

Engineering Supersonic Aerodynamics, by E Arthur Bonney (McGraw-Hill Book Co Inc, New York), 1950, pp xxii + 329 Price $ 3 00

IF AN AERONAUTICAL ENGINEER IS LOOKING for a book that will introduce him to the basic information on the subject of supersonic aerodynamics, he will find such a book in Arthur Bonney's *Engineering Supersonic Aerodynamics* The goal set by the author in his preface is fulfilled in an admirable manner He has endeavoured to present the practical applied information to the engineer engaged in the design of supersonic aircraft

In order to understand the basic principles outlined in the book, one should have a knowledge of differential and integral calculus, differential equations and a thorough understanding of thermodynamics in addition to simple mechanics This book, however, cannot be used as a standard text-book for the graduate course as all mathematical derivations are purposely avoided by the author, whose aim, throughout the book, has been not to disturb the continuity of the physical picture of the supersonic flow

The book consists of seven chapters, beginning with "Compression and Expansion Waves" and ending with the "Composite Design and Performance" A large number of problems is worked out in the body of the book, and at the end of each chapter many typical examples, emphasizing the principles involved, are set for the students to solve.

A few noteworthy features of this volume are the presentation of the graphical results of the conical shock-wave solution by Taylor and Maccoll, the linearized theory solution for bodies of revolution by von Kármán, Tsein and Ferrari, and a descriptive introduction to the supersonic wind tunnel construction and experimental procedure The most recent work on the aerodynamic characteristics of delta wings by Pucket and Stewart is also included In the last chapter, the author concludes the book by briefly discussing the physical aspects of wing-body-tail interference, propulsion and performance

It is observed that the discussion on topics like entropy and enthalpy seems to be somewhat brief and inadequate Today, an aeronautical engineer would better appreciate the physical picture of shock wave if his attention is drawn to the increase of entropy rather than to a decrease of total pressure and hence the reviewer feels that the author should have devoted on the aforesaid topics much more space than what has been done in this book

Though the mathematical treatment is simple and within the scope of an undergraduate student, the physical picture presented in the book seems to be a bit advanced for him to grasp In the opinion of the reviewer, one should have a thorough grasp of the subsonic aerodynamics for conventional types before he proceeds to tackle problems on supersonic aircraft, and this knowledge one can acquire only in the graduate school However, the author is to be congratulated for having written this volume in such a lucid language so as to bring the subject-matter within the grasp of an undergraduate student.

V. CADAMBE

Colours and How We See Them, by H. Hartridge (G. Bell & Sons Ltd, London), 1949, pp xi + 158 Price 15*s*

THE ROYAL INSTITUTION CHRISTMAS LECtures have produced some of the best books on popular science. Dr Hartridge's fascinating volume is the first book based on these lectures to be published since the war

The lectures, which have been improved upon to suit the book form, are more exhaustive than its title is likely to suggest and cover a wide range of subjects. They include, amongst others, a very vivid description of several optical phenomena such as diffraction, interference, polarization, etc One full chapter is devoted to " Some Illusions of Colour " and another to " Colours and Their Uses in Science and Arts " The latter chapter comprises certain details as to how colours are made use of by animals and plants The dominating chapter is the one wherein the author deals at length with the mechanism of vision and claims the superiority of the eye over the photographic camera, for he asks " where is a camera the iris of which adjusts itself according to the intensity of light or the photographic plate which works almost as well for the dim interior of the cellar as it does for the most brilliantly lit landscape ? "

A prominent feature of the book is the large number of illustrations and plates. The methods which the author presents for projecting Newton's rings, spectra and similar phenomena to a large audience are very interesting and should prove of considerable value to teachers for demonstration purposes.

SOHAN SINGH

Electrical Power System Control, Monographs on Electrical Engineering, Vol XI, by H. P Young (Chapman & Hall Ltd., London), 1950, pp xvi+456, Cloth Bound. Price 28*s* net

THIS IS A VERY USEFUL VOLUME IN THE series of " Monographs on Electrical Engineering " under the editorship of Mr H. P Young, and contains valuable information on the operation of generating equipment in large power-stations, regulation of their voltages, synchronizing arrangements and the methods of interconnection with other power-stations. It gives valuable information about the switch-gear and protective equipment of large power-stations

Chapters I to V deal with parallel operation of generating voltage control, types of automatic regulators and their operation, automatic synchronizing of generators and control of power by reactance. Results of latest investigations and developments have been made clear and understandable by men in charge of power-stations as well as those who teach electrical engineering in technical colleges.

Chapters VI to VIII deal with circuit breakers, their design and principles of operation, rupturing capacity, latest development in low oil content and air blast switch-gear, arrangements of power-stations, switch-gear and short-circuit calculations.

Chapters IX to XI deal with interconnection of power-stations and apparatus for such control The principles of automatic supervisory control are clearly explained.

Chapters XII and XIII deal with the automatic protective system for feeders, generators transformers and bus bars Typical protective systems of the latest design and the principles of operation are clearly explained The get up of the book is excellent like other volumes of the series and makes it a very useful addition for the technical library of engineers in the power engineering profession and of colleges

B K R Prasad

Elements of Thermodynamics and Heat Transfer, by Edward F Obert (McGraw Hill Book Co Inc New York) 1949 pp xiv + 372 Price $ 4 50

THE BOOK UNDER REVIEW IS A VERY WELCOME addition to thermodynamic literature While there are excellent treatises on thermodynamics both on the elementary and the advanced portions of the subject there would appear to be a real need for books intended mainly for students taking up an engineering course The aim of the author has been to satisfy this demand No one who has gone through the pages of this book would deny that the author has succeeded in this purpose remarkably well He can also justly claim that the presentation of the subject has been throughout simple and direct without sacrificing rigour or the emphasis on the fundamental aspects and continuity of the Science

The book begins with a chapter on units and dimensions The student should find this particularly useful since the subject has considerable applications in other branches of engineering and a basic knowledge of it will therefore greatly facilitate his work The second chapter deals with the fundamental concepts of thermodynamics like energy work state etc The next three chapters are devoted to a treatment of the first and second laws of thermodynamics The properties of liquids and gases are discussed in chapters VI VII and VIII Chapters IX to XIV deal with the application of thermodynamics to fluid flow power cycles and refrigeration The last chapter is on heat transfer A specially noteworthy feature of the book is a selection of fine and well graded examples which an engineer often comes across in his everyday work There are also useful appendices on physical constants for ready reference

By way of criticism the reviewer feels that the arrangement of the text at certain places could have been a little different leading to some gain in logical coherence and elimination of repetition For example the definition of heat capacities and specific heats occurs as late as in page 57 in the middle of a discussion on reversibility Thermodynamical calculations are postponed to chapter XI thus slightly obscuring their dependence on the first law Discussion of the boilers reciprocating piston pumps etc immediately after defining the first law in chapter III looks rather early The carnot cycle has been virtually discussed thrice in chapters V XII and XIII Incidentally no mention is made of Hess s law in connection with thermochemistry With regard to chapter XIV on refrigeration a fuller discussion of heat pumps and their applications in industry would have been more profitable as this is a subject which is fast developing The introduction or at least a brief mention of Maxwell s relationships and their applications would have been welcome in later chapters on account of their importance in thermodynamics

Apart from these minor points the book will prove to be a valuable introduction to basic thermodynamics for engineers The get up of the book maintains the high standard set up by the publishers The diagrams are excellent and illustrate the text extremely well

P K Kichlu

Railway Track, by K F Antia (New Book Co Ltd Bombay) 1949 pp xix + 416 Price Rs 16

IN BRINGING OUT THE SECOND EDITION OF his book on railway track which is quite pleasing and attractive the author has endeavoured to include the latest and more up-to date methods in the construction and maintenance of railway track For this purpose he has revised most of the chapters and added a new chapter on track stresses The author s experience as Deputy Chief Controller of Standardization in the Central Standards Office for Indian Railways has afforded him the fullest opportunities to come into contact with recent investigations and research on tracks in India and elsewhere and the information he has furnished should be of considerable benefit to those who are engaged in similar investigations

The book contains very useful information and is a valuable guide to track engineers and inspectors Its utility would however have been enhanced if the fundamental principles underlying the design of track sub-structure and super-structure were treated with greater clarity. As it is, the inexperienced reader may be bewildered with the mass of details and apt to miss the basic principles This is perhaps inevitable as the book was originally prepared from the notes taken by the author during his work in the railways His second edition is, however, a great improvement on the first in this respect.

A few statements made by the author are misleading and require correction In the first chapter, on page 6, the maximum axle loads in India are stated to be 28 tons for broad gauge, 17 tons for metre gauge and 13 tons for narrow gauge Although at one time these axle loads were contemplated, no locomotive was actually built for Indian railways with such heavy axle loads and the maximum axle loads on Indian railways have so far been limited to 22·5 tons, 12 tons and 8 tons respectively for broad, metre and narrow gauges In the second chapter, on page 12, it is stated that the approximate permissible axle load in America is taken as 300 times the weight of the rail per yard. This reference should have been the wheel load and not the axle load

In the chapter on track stresses (page 93) the magnitude of the steam effect is stated to be small. In practice, the steam effect is quite appreciable when compared to the hammer blow due to the overbalance as the figures on page 97 against hammer blow and steam effect reveal The statement in the seventeenth chapter on page 297 that the wrong type of spring or alteration in the length of the spring hanger might completely unload the wheel is exaggerated Within limits and provided the compensating beam does not touch the stop, variation in the length of hanger is not considered to be of material importance

On the whole, track men should feel greatly indebted to Mr Antia for this book which provides a very handy and useful manual for permanent way

V V.

Canning Practice and Control, by Osman Jones (Chapman & Hall Ltd, London), 1949, Third Edition, Revised & Enlarged, pp vi + 314 and Index. Price 36s. net

THE GREAT POPULARITY OF THE FIRST TWO editions of the book has led to the publication of the third edition. Mr. Osman Jones is the sole author of the present edition, Mr J. W. Jones having resigned his rights of co-authorship.

During the seven years that have intervened between the publication of the second and third editions there have been many developments in the theory and practice of canning and the author has made a thorough revision of the subject-matter in the light of these developments. Particular mention may be made of the recent methods of vitamin assay, examination of suspected materials in food poisoning cases, new culture media, modern sealing compounds, etc The microbiology of canning is discussed at length and the importance of hygienic conditions in canning practice has been clearly brought out In this chapter the author has been eminently successful in imparting to his readers, who may not have had any grounding in bacteriology, an understanding of the implications of microbiology as applied to canning.

The book is profusely illustrated with photographs of processing techniques employed in canning and photomicrographs of spoilage micro-organisms It is regrettable that several misprints have crept in, and we have no doubt that these will be eliminated while reprinting the volume.

S A.C.

Publications Received

PRINCIPLES OF AERODYNAMICS, by James H Dwinnell, McGraw-Hill Book Co Inc., $ 5 50

CHEMICAL ENGINEERS HANDBOOK (Third Edition), by John H Perry, McGraw-Hill Book Co Inc., $ 12.50

CHEMICAL AGE, C 19 Sitaram Buildings, Bombay 1, Rs. 10

WELDING DESIGN & PROCESSES, by B. Richard Hilton, Chapman & Hall Ltd., 36s.

PROGRESS IN CHROMATOGRAPHY (1939-1947), by L. Zechmeister, Chapman & Hall Ltd., 45s.

CELL PHYSIOLOGY & PHARMACOLOGY, by J. F. Danielli, Elsevier Publishing Co. Ltd., $ 3 00

DRILLING & SAMPLING OF BITUMINOUS SANDS OF NORTHERN ALBERTA, Vol. 1, Canada Department of Mines & Resources, 25 cents

Non-Technical Notes

MANUFACTURE OF FILTER PADS FOR STERILIZING LIQUIDS

SPECIAL TYPES OF FILTER PADS ARE required for preparing bacteria-free filtrates in pharmaceutical and biological work Prior to the World War, the country's requirements of such pads were met by imports of well-known foreign brands such as the Seitz E.K. pads manufactured in Germany. With the cessation of supplies from Germany and other foreign sources during the war, there was an urgent demand for the manufacture of these pads in this country As a result of the investigations carried out in the laboratories of the Council of Scientific & Industrial Research, a process has been worked out for their manufacture from raw materials readily available in the country The pads manufactured by this process satisfy all the standard specifications with respect to sterility of the filtrate, rate of filtration, etc

The process consists of the following steps

1. Preparation of the absorbent
2. Preparation of the pulp medium
3. Incorporation of the absorbent powder in the pulp medium.
4. Preparation of the final suspension
5. Preparation of the pads

The following equipment costing about Rs 2,500 is required

1. Aluminium or enamelled pans
2. Mechanical shaker
3. Sterilizer to stand a pressure of 50 lb. per sq. in
4. Vacuum pump
5. Hot-air oven.
6. Hand press.
7. Punches, dies, etc

Manufacturing Cost

	Rs.	as	p.
Cost of raw materials and chemicals per 1,000 pads of 7 cm. dia. .	12	0	0
Manufacturing costs	13	0	0
Cost per set of 25 pads . .	0	8	0

As these pads are to be used for aseptic purposes, it is necessary to pack them in properly sterilized paper or plastic covers

The demand for these pads was fairly heavy during the last World War and is likely to grow with the development of industries concerned with pharmaceutical or biological processes involving aseptic filtration. The manufacture of these pads can be profitably taken up by surgical goods manufacturers

PRODUCTION OF CITRIC ACID

CITRIC ACID AND CITRATES ARE IMPORTANT chemicals with a variety of industrial applications They are used in pharmaceutical preparations, in the food industries and, to a lesser extent, in dyeing and calico printing, silvering, engraving and in ink manufacture Citric acid and citrates also find application in the plastics industry

Citric acid is now manufactured almost entirely by the mould fermentation method India's requirements of citric acid, averaging to 250 tons per annum, are met entirely by imports The panel on Fine Chemicals, Drugs and Pharmaceuticals, in fixing a target of production for citric acid, assessed the country's annual requirement at 500 tons by 1957 In view of the rapid growth of the pharmaceutical industry and of the aerated waters' and soft drinks' industry in India, the target may be exceeded in the near future

Investigations on citric acid fermentation carried out under the auspices of the Council of Scientific & Industrial Research have resulted in the isolation of a giant strain of *Aspergillus niger* with outstanding citric acid producing ability, and in establishing the conditions under which this fungus can be employed for the commercial production of citric acid An important feature in the use of this organism is that no oxalic acid is produced during fermentation The fungal mycelia, obtained in the process, has been used in the production of calcium gluconate

The method consists essentially in fermenting technical glucose or cane sugar under controlled conditions, employing cultures of the special strain of *A. niger* mentioned above Conversion of glucose to citric acid takes place in 9 to 10 days, after which the fermented liquor is filtered, concentrated and the citric acid allowed to crystallize out The yield in terms of the weight of raw material used up is 70 per cent with glucose and 50 per cent with cane sugar When molasses are used, the yields are not consistent.

RAW MATERIALS

1. Technical glucose or cane sugar
2. Ammonium nitrate, potassium dihydrogen phosphate and magnesium sulphate
3. Slaked lime and sulphuric acid (if alternative recovery process *via* calcium citrate is adopted)

EQUIPMENT

1. Fermentation chamber of cement concrete for one ton plant, 112½′×70′×16′
2. Fermentation trays of aluminium or sheet iron or wood suitably coated
3. Sterilization vessel, wood
4. Sedimentation wooden tank
5. Filter presses (plate and frame type and rotary type)
6. Vacuum evaporators, either lead-lined or of stainless steel
7. Settling and decolourization wooden tanks.
8. Jacketed enamelled iron crystallizing vessel
9. Basket centrifuge
10. Air-conditioner, and
11. Boiler

CAPITAL OUTLAY (for 1 ton of citric acid per day)

		Rs
1	Fermentation chamber @ Rs 10/- per sq ft	1,00,000
2	Air-conditioning equipment	40,000
3	Evaporators	80,000
4	Trays and other equipment	80,000
5	Boiler	15,000
	TOTAL	3,15,000

PRODUCTION COSTS

(a) *Glucose as Raw Material* —

		Rs	as	p
1	Technical glucose, 1 43 tons, @ Rs 70/- per cwt	2,002	0	0
2	Other chemicals	400	0	0
3	Power @ -/1/- per kW	50	0	0
4	Steam, 17 tons, @ Rs 10/- per ton	170	0	0
5	Depreciation @ 15 per cent	150	0	0
6	Insurance @ 2 per cent	20	0	0
7	Salaries and wages	160	0	0
	Cost of 2,240 lb of citric acid	2,952	0	0
	Cost per lb	1	5	0

(b) *Using Cane Sugar as Raw Material* —

		Rs	as	p
1	2 tons of cane sugar @ Rs 40/- per cwt	1,600	0	0
2	Other expenses [as in (a) 2-7]	950	0	0
	Cost of 2,240 lb of citric acid	2,550	0	0
	Cost per lb	1	2	3

(The estimates are based on laboratory experiments.)

MANUFACTURE OF CALCIUM GLUCONATE

AS A RESULT OF THE WORK CARRIED OUT IN the laboratories of the Council of Scientific & Industrial Research, a simple enzymic process has been developed for the production of calcium gluconate. The method which is covered by *Indian Patent No* 39441 and corresponding foreign patents, has the following advantages over the older fermentation methods (i) avoids the use of live cultures and, consequently, no special precautions or equipment are required for sterilizing media, etc, (ii) the equipment required is simple, (iii) fungal mycelia from citric acid or penicillin production are utilized in the process, and (iv) side reactions are avoided and, consequently, the purity and yield of gluconic acid are improved. Technical glucose or starch hydrolysate is employed as raw material

RAW MATERIALS

1. Technical glucose or starch hydrolysate
2. Calcium carbonate

EQUIPMENT

1. Shallow pans (total area, 50 sq ft) for culturing the organism
2. Refrigerator (household) for storage of culture
3. Laboratory autoclave
4. Aeration vessel made of wood with stirrers.
5. Filter press, wooden frames and plates
6. Vacuum evaporator of stainless steel
7. Shallow hemispherical crystallizing vessels with enamelled stainless steel anchor stirrers
8. Centrifuge
9. Storage vessel made of wood,
10. Drying oven
11. Grinder, and
12. Compressed air plant

CAPITAL COSTS

		Rs
1	Cost of equipment for a plant capable of producing 250 lb of crystalline calcium gluconate in two days	1,00,000
2	Cost of building, 2,000 sq ft., @ Rs 10/- per sq ft	20,000
	Total capital cost excluding cost of land	1,20,000

WORKING EXPENSES

	Rs.	as	p
Cost of 500 lb of technical glucose @ Rs 70/- per cwt	310	0	0
Cost of calcium carbonate	21	0	0
Sundry chemicals	12	0	0
Electricity and fuel	30	0	0
Depreciation @ 15 per cent	120	0	0
Insurance @ 2 per cent	16	0	0
Labour and supervision	60	0	0
Cost of 250 lb of calcium gluconate	569	0	0
Cost per lb of calcium gluconate	2	4	0

(The estimates are based on laboratory experiments.)

NOTES & NEWS

Scientific Supplies Stores in India

THE LEADING ARTICLE PUBLISHED in a recent issue of *Current Science* puts forth a plea for the establishment of scientific supplies stores in India (1950, 19, 167). At present essential supplies, research equipment, glassware and chemicals are obtained by Government departments, research institutes and the universities through (1) reputed commercial concerns or (2) some government agency such as the Indian Stores Department, Director-General of Industries and Supplies, Trade Commissioners, Scientific Liaison Officers and Supply Missions attached to the Indian Embassies, etc. It is estimated that the cost of articles obtained through commercial concerns is 2½ to 5 times more than when the stores are directly imported. This is attributed to the absence of any central organizations for obtaining these supplies and arranging for their storage and distribution.

The establishment of regional scientific supplies stores, at important centres, to be either directly in the charge of the Department of Scientific Research, Government of India, or to be managed by a private firm under the control of the Central Government, is suggested for speedy and economic procurement of scientific supplies. Research institutions, university laboratories, etc. within the orbit of each of these centres would be served effectively from these centres. Each of these centres would collect the requirements for the next two years of various institutions in their zones, secure currency releases for articles to be imported, call for quotations, arrange for inspection and stock the material. The laboratory or the department concerned would then merely arrange to draw from these stores its requirements as and when needed.

This procedure would save much unnecessary expense and delay in procurement of supplies and would effect a substantial saving in cost of materials as also in packing, freight, insurance costs, etc. Moreover, research and other institutions would be saved a lot of administrative work in arranging for these supplies.

Exhibition of Scientific Instruments

A WIDE VARIETY OF SCIENTIFIC instruments and associated apparatus designed for industrial and power application and scientific process control in industry were on display at the 34th Physical Society Exhibition held in April 1950 at the Imperial College, London.

Among the pick-up, or initial measuring devices the emphasis was on instruments measuring radioactivity, e.g. an instrument measuring material thickness by radioactive means. Radiation detection and measurement apparatus, varying from simple Geiger Muller counters to radioisotope analysers was demonstrated. Among the amplifiers, 12 different designs of d.c. or a.c. amplifiers suitable for application to the measurement of small currents or potentials were incorporated. Some examples of new miniature electrical instruments covering all types of movements were shown and also a neat and small frequency meter with 5 vibrating reeds for use on 50 c./s. A new compact dynamometer has been produced. A small compact moving coil grapher in a metal case, a 3 in. wide chart with two paper speeds, was the most prominent of the graphic recording instruments. A compact single pen operation grapher or marker with an eight-day mains driven drum chart, was on show. This was developed for statistical investigation of consumer demand when using water-heaters and similar appliances and records the time and duration of the load.

Three new instruments for process control were exhibited. The largest has a 10 in. wide chart with self-contained motor-driven pen and integral potentiometer balance. Full scale deflection is given for 10 mV. For portable use one type was shown which could be servo-operated. The whole equipment could be accommodated in a portable case with a disc chart record. The use of electro-sensitive paper was a feature of several other recording instruments.

Improved forms of voltage regulators and transformers were exhibited. A transformer for high frequency use which can deal with loads of 500 VA, was notable for its small size. An equipment, designed for stabilization of a.c. voltages for accurate laboratory work, has a short term stability within two parts in 10 000. A valuable accessory for control purposes was the vacuum switch. Two new magnetically operated models work with 15A a.c. or d.c. at 600V respectively and the same current at 1,500V in 10 milliseconds.

A powerful miniature self-starting motor having a torque of 0·75 in. per oz. at 3 000 r.p.m., was shown. Its larger prototype produces 6 in. per oz. at the same speed. Other designs with various terminable shaft speeds and torques were also available.

Some new portable test instruments for laboratory and industrial use were put on show. One portable wattmeter was capable of measuring power without breaking the circuit and is available in ranges from 50 kW upwards; a plug-in ammeter movement was also available.

New additions to the wide range of insulation testers were made. One of these hand operated, had a maximum test pressure of 2 500V d.c. and six ranges from 50 000 megohms downwards while another with a test pressure of 5 000V d.c. had ranges down from 1 00 000 megohms.

Many demonstrations were suggestive of the future trends in development. The use of the Hall effect in germanium crystal was one example. Two prototype equipment was operated to show how accurate measurements of magnetic flux may be made using a tiny probe 3 mm square; this would be of immense help in investigations of complicated or small magnetic circuits (*Electrical Review*, 1950 No. 4).

Mercerization of Jute

THE TRANSFORMATION OF NATIVE cellulose (Cellulose-I) into the hydrate modification (Cellulose II) by the action of caustic soda on raw jute has been studied at the *Textile Physics Laboratory* University of Leeds (*Nature* 1950 165 818)

The soda cellulose obtained by treating raw jute without tension in caustic soda solutions of various concentrations was examined for the native modification which was found to be absent for concentrations greater than 10 per cent (w/w) but reappeared when alkali was washed off The incomplete transformation therefore is not due to the failure of the alkali to penetrate into the cellulose crystallites but to at least partial reversibility of the native→soda cellulose reaction

In ramie the conditions for a partial transformation of this kind are much more critical and appear to be such that only part of the cellulose has been acted upon by alkali The differential behaviour from jute is ascribed to the effect of lignin in the latter when perhaps by forming cross linkages between the cellulose chains near the boundaries of the crystallites it introduces an element of stability absent in the purer fibres Another effect which is observed only in jute for a narrow range of concentrations of the alkali (about 10 per cent) is the formation of an abnormal soda cellulose I and is perhaps the consequence of extra crystallite cellulose lignin linkages

Direct Plating of Aluminium

A NEW PROCESS FOR DIRECT plating of aluminium with the help of a suitable etching agent has been developed at the Food Investigation Organization of the D S I R London (*J Electrodepositors Tech Soc* 1950 **26**)

The relative efficiency of various etching agents was determined by immersing etched and washed specimens in a solution of iodine (containing 0 1 *N* iodine and 0 13 *N* sodium iodide)

Etching solutions containing acid in combination with the chloride ion viz sulphuric (H_2SO_4—HCl) hydrochloric (HCl NaCl HCl $AlCl_3$) acetic (CH_3COOH—NaCl) and trichloracetic (CCl_3COOH) were the most effective in dissolving the surface film Trichloracetic acid etches best taking only one or two minutes and leaving a very smooth surface free from pits The addition of a hydroxy organic substance e g dextrin to the etchant forms a soluble complex salt with aluminium and prevents the precipitation of aluminium hydroxide or basic salts of aluminium The best etching solution found so far consists of dextrin 50 gm water 150 c c trichloracetic acid (melted crystals) made to 1 litre The average loss of aluminium (99 3 per cent) incurred during etching at 95°C for 1 to 2 min was 0 14 gm per cm^2 (1 3 gm per sq ft) of surface area equivalent to removal of 0 0005 cm (0 0002″) thickness

The disadvantages of this etching agent are (1) the cost is higher than that of the usual etchants (2) the solution is rather viscous and the loss through drag out is likely to be appreciable (3) the fumes which arise at 95°C are objectionable and steps must be taken to reduce or eliminate them and (4) the operator needs to wear rubber gloves

The activity of the aluminium at the time of plating has to be maintained by washing in an inert liquid such as acetone or it can be reduced by means of a controlled wash in water or a mixture of acetone and water The results of tests on the effect of varying the time of immersion of etched aluminium in cold or boiling water on the electrodeposition of nickel (from nickel sulphate solution) showed that a brief rinse in boiling water or 30 min in cold water permitted a good deposit Cold water treatment gave thinner and better conductive films than those formed in boiling water Further washing should be done with minimum exposure of the etched surface to air and the metal should not be allowed to dry before immersion in the plating solution

The following have given the best results for plating copper and nickel as aluminium after the preliminary etching treatment in the trichloracetic dextrin solution

Chemical Displacement Copper—The etched metal is washed in two separate lots of acetone rinsed in a mixture of equal parts of acetone and water and immersed in a saturated solution of copper sulphate for 3 to 10 min at room temperature *Nickel*—The etched metal is treated as above and immersed in the following solution for about 15 min at 95°C nickel sulphate 250 gm nickel chloride 50 gm ammonium citrate 100 gm *Perminal* BX 3 gm made to 1 litre with water The coatings thus produced have a good appearance and permit a fairly strong soldered joint but are porous and may possibly serve as undercoats for an electro-deposited metal

Electro-deposition Copper—The etched metal is treated as above and plating is done in an agitated solution of the following composition for 2 min at 50 amp per sq ft and then 13 min at 25 amp per sq ft at room temperature using a copper anode and a bath of copper sulphate 300 gm boric acid 20 gm *Perminal* BX 2 gm made to 1 litre with water *Nickel*—Treated as for copper and plating is done in the following solution for 30 min at 50 amp per sq ft at room temperature using nickel anode and a bath of nickel sulphate 100 gm ammonium sulphate 50 gm boric acid 2 gm made to 1 litre with water

Stainless Steel Linings

THE COMPARATIVE MERITS OF stainless steel lined stainless steel clad and solid stainless steel equipment and the welding techniques employed in these vessels are discussed (*Chem Eng* 1950 57 117)

Considering the wall thickness the following linings are recommended as most economical 0 25 in or under solid stainless steel a careful comparison of costs is necessary 0 25 to 0 5 in solid stainless steel and stainless steel clad 0 5 to 1 0 in stainless steel clad and stainless steel lined 1 0 in or more stainless steel lined 0 75 in or below in conditions severely corrosive solid stainless steel 0 75 in and above conditions severely corrosive either clad or lined construction

Plug welding strip welding spot welding and poke welding are commonly used The choice of a particular method is determined by the vessel design operating conditions and skill of workmen

Plug Welding — The method is easier to test for leaks and is found satisfactory in many cases There is little opportunity for crevice corrosion if the plugs are properly sealed Comparison of plug welding costs with those for strip welding method is of the order of 10 to 30 per cent more expensive than 2 bead butt weld 5 to 15 per cent more expensive than 3 bead butt weld and lap weld with formed edges and about 15 per cent less expensive than the butt strap arrangement The method however does not neces sarily afford stronger attachment to the shell than the strip method in fact there is more possibility of harmful dilution of weld metal in plug welds than in any of the strip methods except the single bead butt weld

Strip Lining—The major variations of method are three bead two bead and single bead butt welds butt straps lap welds with formed edges and shingle method In three bead butt weld laying of the cover bead is not easy and fit up is rather exacting It is slightly more expensive than lap weld with formed edges and less expensive than butt strap Two bead butt weld offers the best all round combination of freedom from dilution and crevice corrosion and ease of fit up at moderate cost Single bead butt welds have been successfully used in lining work but require the highest welding skill to securely attach the liner and seal the joints with one bead Even then dilution and crevice corrosion are more likely and unsound welds may occur Use of a butt strap is the most satisfactory although it is the most expensive on account of four welds required for each joint Lap weld with formed edges is as satisfactory as the butt strap Cost of forming is more than overcome by using only two beads per joint instead of four The ridged effect however may cause some inconvenience in cleaning Shingle method is a variation of lap weld with formed edges The method is seldom used because it is difficult to make the lapping edge meet properly the flat surface of the lapped strip with the result that the welds are unsound and not crevice free

Spot welding methods have been quite successful especially when the vessel interior is new and smooth The method and the equipment are patented

The poke welding gun making use of the inert gas shielded arc principle is a recent development The gun fusion welds two lapped pieces of metal without the necessity of making holes in either piece It is applied to only one side of the joint The equipment is patented

Petroleum from Oil Sands

THE DEMONSTRATION PLANT AT Bitumount Canada the site of Alberta s Oil Sands Project on the Athabaska river is the only plant of its kind in the world extracting petroleum from Alberta's oil rich sands These deposits constitute the largest single reservoir of petroleum in the world and are estimated to contain 100 billion to 500 billion gallons of oil The separation and refining processes employed are described (*Chem Eng* 1950 57 103)

The oil sand deposits consist of unconsolidated sand clay and silt containing varying amounts of heavy asphaltic oil 4 per cent to 16 per cent by weight The sand particles are 50 to 200 mesh and the oil is largely in the form of thin films surrounding the sand grains

The sand is fed to the plant through steam jacketed screw conveyers after injecting it with high pressure steam Hot water is added to adjust the gross water content of the feed to about 12 per cent by weight A rotary screen removes limestone and other foreign bodies The oil sand passes through the screen as a heavy pulp containing about 25 per cent by weight of liquid Adjusting a weir at the discharge end regulates retention time in the mixer During mixing the oil film surrounding each sand grain is broken and the sand is wetted with water The tiny air particles so formed coagulate to form droplets These are aerated by agitation in the mixer

In the distributor the oil water and sand are mixed with 200°F recycle water circulating at 400 gal per min The sand enters the separation cell as individual grains and oil inclusion is prevented Conditions in the cell are quiescent so all but the finest mineral matter settles rapidly and is carried along through the bottom to the foot of a twin screw dewatering conveyer which lifts the sand above the liquid level in the cell before discharging into the tailings receiver The oil water interface in the separation cell is maintained slightly below the reach of three sets of rotating paddles that carry the oil out of the cell A conventional thickener removes almost all fine clay particles mixed with the oil sand

Oil leaving the separation cell contains 25 to 30 per cent water and 4 per cent mineral matter This is cleaned up by diluting settling and flash vaporizing the water Diluent is a 30° API distillate produced in the refinery Water in the diluted crude is removed by heating to 400°F under 20 to 30 p s i back pressure in a conventional tube still and flashing Distillate flashed with water is recombined with dry crude from the bottom of the flash water

Refining is restricted to a mild vis breaking operation (1) recovery of diluent added to facilitate cleaning of the crude (2) production of new diluent to balance production losses and (3) production of fuel oil for the power house refinery heater and dehydration heater

Dry diluted crude oil is heated to 825°F under 50 p s i back pressure and flashed Overhead from the flash tower is fractionated into naphtha distillate light gas oil and heavy gas oil Heavy gas oil is recombined with the flash tower bottoms and the blend used as fuel

Pilot plant trials of a cold water separation process and a fluidized bed operation are under investigation

Recovery of Stainless Steel Scrap

A NEW TECHNIQUE OXYGEN LANCING which speeds up the production improves the quality and reduces the cost of stainless steel was discussed at a recent meeting of the British Iron & Steel Federation (*Chem Age* 1950 62 819) The technique is regarded as an important development in the manufacture of stainless steel since its initial discovery The new process makes possible the utilization of stainless steel scrap

The scrap is melted in an arc furnace at 3 000°C and pure oxygen is blown into the steel through a long thin pipe thrust through the door of the furnace The oxygen oxidizes silicon and manganese which tend to increase the temperature of the molten steel Subsequently carbon (contamination from the electrode) is burnt or oxidised and its content can be brought down to 0 05 per cent During oxygen injection some chromium is oxidised thereby generating more heat and this chromium mainly passes into the slag At a later stage this chromium is made to pass back into the molten steel to the extent of about 96 per cent Thus four fifths of the chromium in the metal is retained when a stainless steel with 18 per cent chromium is made and all of it is retained when processing a rustless steel with 12 per cent chromium thereby effecting a considerable saving of the expensive metal and obviating the necessity of rebuilding the chromium content Great saving in electric current is also effected by this method 10 minutes of oxygen lancing completes the operation which would normally take 30 to 45 minutes by the old method The steel made this way takes high polish quickly

Rapid Analysis of Silicates

THE STANDARD METHODS OF ANALYSIS of clays and other silicates are time consuming and are not very accurate Colorimetric and spectrographic methods developed and perfected at the Royal Institute of Technology Stockholm and at the University of Ghent respectively (*Research* 1950 3 74) offer rapid and simplified analytical techniques

Colorimetric Method — Three solutions of the clay sample are prepared The first solution for determination of SiO_2 Al_2O_3 Fe_2O_3 and TiO_2 is obtained by fusion of 0 2 gm of clay with sodium carbonate precipitation of silica by hydrochloric acid and separation from chlorides of iron aluminium and titanium and dissolution of silica in sodium hydroxide to form sodium silicate Each filtrate is made up to 1 litre Silica is determined colorimetrically in this solution by the yellow colour produced on forming silico molybdic acid the Al_2O_3 by the yellow colour formed with aluminon the Fe_2O_3 by the red colour formed on addition of potassium thiocyanate and the TiO_2 by the yellow produced by hydrogen peroxide

The second solution for the determination of calcium and magnesium oxides is obtained by the fusion of 0 5 gm clay with sodium carbonate precipitation of silica with hydrochloric acid addition of hydrogen peroxide to dissolve MnO_2 as the chloride precipitation of iron aluminium and titanium as their hydroxides by ammonia and filtration of the solution into a 250 c c graduated flask The precipitate is redissolved in hydrochloric acid reprecipitated by ammonia and washed with four portions of 2 per cent ammonium chloride solution The washings are added to the filtrate in the 250 c.c flask the whole acidified with hydrochloric acid and made up to 250 c c Calcium oxide is determined by precipitation as calcium oxalate and titration with decinormal potassium permanganate Magnesium oxide is determined colorimetrically by means of titanium yellow which on co precipitation with magnesium hydroxide produces a red colouration

The third solution for determination of alkalies is obtained by treating 2 gm of clay with hydrofluoric and sulphuric acids followed by neutralization with ammonia to *p*H 5 and washing of the precipitate with hot water The filtrate is made of 200 c c in a graduated flask Sodium oxide is estimated by precipitation with uranyl acetate and estimated colorimetrically by the brown colouration formed with uranium in presence of hydrogen peroxide and ammonium carbonate Potassium oxide is estimated by precipitation with chloroplatinic acid and addition of potassium iodide when a red colouration is formed due to the $PtI_6 2$ ion

Complete analysis of clay with this method can be finished within 8 hr The results are comparable in every way with the results obtained by gravimetric methods The method is applicable to the analysis of mica feldspar sands slags from blast furnaces and cement It requires a combined colorimeter and nephelometer with two photoelectric cells of a selenium barrier layer type connected by a compensating circuit to a galvanometer as null point indicator

Emission Spectrographic Method — A master solution for determination of Al_2O_3 Fe_2O_3 TiO_2 CaO and MgO is prepared by dissolving 1 gm clay in hydrochloric and sulphuric acids in a platinum crucible so as to volatilize the silica After evaporation to dryness the residue is taken up in hydrochloric acid and warmed to dissolve the salts completely This is again evaporated to dryness and redissolved in 10 c c of a standard copper sulphate containing 2 5 gm copper in 1 litre of 2 *N* HCl 0·02 c c is evaporated at 90°C on a Hilger graphite electrode of 5 mm diameter with a flat surface previously cleaned by a preliminary discharge for 1 min The upper electrode is also of graphite and the excitation is by intermittent arc The intensity of the lines is compared with that of the copper which furnishes an internal standard The curves produced permit the determination of Al_2O_3 Fe_2O_3, TiO_2 CaO MgO and Na_2O in various concentration rays Very low concentrations are obtained on further simple treatments of the master solution Silica is determined by difference

More rapid determinations may be carried out by working directly on a specimen of finely powdered clay 0 1 gm clay 0 4 gm copper oxide and 0 5 c c alcohol are mixed in an agate mortar and ground finely until the alcohol has completely evaporated The mixture is dispersed in 1 c c alcohol and in order to deal with the whole of the suspension it is withdrawn by means of a glass tube of diameter less than that of the flat electrode and placed on the electrode the alcohol disappears by absorption and evaporation Except sodium and potassium oxides (which cannot be determined by this method) the other oxides can be determined in concentrations of 1 per cent and below A maximum of 15 to 20 min is required for the determination of the principal constituents Reproducibility is excellent with a mean error of 3 to 5 per cent

New Rabies Vaccine

A NEW VACCINE FOR PROTECTING dogs against rabies is reported (*Sci Newsletter* 1950 57 279)

The vaccine is made from a live rabies virus modified by growing in chick embryos and unlike the older vaccines does not contain any mammalian brain or spinal cord tissue The vaccine provides a high degree of immunity Dogs inoculated with a single injection were found to be completely resistant to virus infection for 5 to 27 weeks The chick embryo vaccine is highly stable and maintains its immunizing capacity for at least 18 months

Improved Metal Cleaner

A NEW AND SIMPLE METHOD FOR making and using di phase metal cleaners with very good detergent properties is based on a system in which the water and solvent remain as separate layers

The solvent consists of a chlorinated solvent such as trichlorethylene to which is added mineral spirits to give a final specific gravity greater than the water layer which remains on top of the solvent Phosphates are frequently added to the water to help in removing water-soluble dirt from the metals.

The efficiency of this system depends on the addition of polyethylene glycol 400 (di, tri) Ricinoleate S-556U (*Glyco Products Co Inc*, U S A) about 0 5 per cent to the solvent. S-556U acts as an organic solvent wetting agent for the metals, helping to remove grease and oils from the metals rapidly Not only does it act as a preferential wetting agent in the solvent for metals, but also as an emulsifying agent when the metal parts are raised through the water layer, causing more effective removal of trace grease and other adhering dirt

Cleaning by this di-phase system is done simply by dipping the metal parts through the water layer into the solvent and then, after a short time, bringing them up through the water layer with a minimum of agitation Heating is not resorted to at any stage, thus eliminating toxic fumes, fire hazard, loss of solvent and change in composition of the two phases

Sheep-marking Composition

A NEW SHEEP-BRANDING FLUID, which eliminates special processing and does not harm the sheep or the wool, has been produced by the Australian Commonwealth Scientific & Industrial Research Organization after seven years of research and investigation (*Agr Newsletter*, Australia)

The composition is prepared as under Lanolin (26 lb), resin (10½ lb), stearic acid (7 lb) and tallow (3½ lb) are melted at 230°F The molten mixture is poured slowly into an ammonia solution (sp gr 0 88) with slow mechanical stirring A preservative such as toluene or oil of eucalyptus phellandra (1 lb) is then added with stirring and a suitable pigment (5 lb), e g Monolite Scarlet R N S, Monastrol Blue B S weak, or carbon black is mixed in The product keeps well without any sedimentation for at least three years and its marks on sheep are readable for as long as 12 months.

High Frequency Induction Furnace

A HIGH FREQUENCY 5 kW INDUCTION furnace for metallurgical research has been designed at the Research Laboratories of the *General Electric Co* Two types are illustrated (FIG 1) The 5 kW one is the smaller of the two

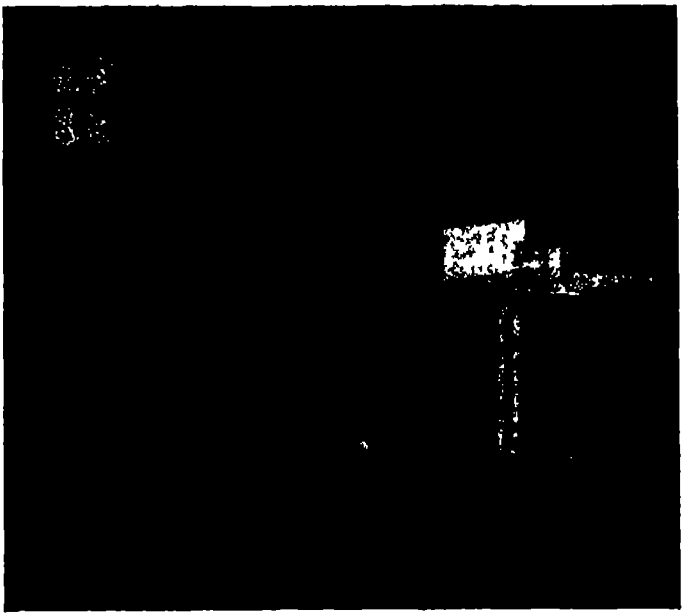

FIG 1 — HIGH FREQUENCY INDUCTION FURNACE

The furnace is housed in a sheet metal cabinet with a top of heat-resisting material A lever operating through a notched gate is used to raise or lower the crucible and during operation the furnace is covered with a lid which has a small hole to allow for the observation of the charge or for the insertion of a pyrometer The lid, table top and removable rear panel are all fitted with safety switches to prevent power being switched on when they are not in a position A graphite and refractory crucible is used with the equipment Power for the furnace is supplied from a 5 kW high frequency heating generator and the overall consumption, when the equipment is in full operation, is 10 kW from a 400 to 440V three-phase supply Typical performance figures for the plant are 2 kg of copper can be melted in about 15 min and 1 kg of steel in 12 to 15 min.

Chemical Survey of Australian Plants

MORE THAN 750 AUSTRALIAN plants have been examined as sources of drugs and chemicals in a recent survey conducted jointly by the C.S.I.R.O and the Universities of Melbourne, Sydney and Queensland The survey has been specially initiated to search for plants which might provide a starting-point for the manufacture of cortisone, which shows promise in the treatment of rheumatoid arthritis Plant saponins, it is suggested, may make possible the large-scale production of this substance

One hundred and forty-five of the plants examined seem likely to contain alkaloids which are being identified Eleven plants have been found to contain prussic acid and may be dangerous to stock under certain conditions of growth

Timber for Packing Cases

A PRELIMINARY SURVEY OF INDIAN timbers suitable for the manufacture of packing cases has been made in a pamphlet (*Indian Forest Leaflet No* 106), recently issued by the Forest Research Institute, Dehra Dun The survey shows that there are extensive possibilities for the manufacture and supply of box shooks from indigenous timbers.

Besides listing the various timbers which are already in use for making packing cases, names and descriptions of other woods which are considered suitable but have

Conservation of Museum Objects

THE INTERNATIONAL INSTITUTE for the Conservation of Museum Objects recently established with its headquarters in London fulfils an urgent need for an organization aimed at setting and maintaining a high standard of skill and competence in the conservation of all kinds of valuable and artistic material and national treasures Its office bearers are authorities of international reputation in their respective fields and Dr G L Stout formerly Head of the Department of Conservation and Research Fogg Art Museum Harvard University is its first President

The Institute will help to bring about collaboration between experts of different nations and those intimately interested in conservation of museum objects The organization will pay particular attention to the training of personnel in the theory and practice of conservation and co-operate with all institutions providing for such instruction The Institute proposes to publish from time to time articles on technical studies in the field

A booklet giving full details of the Institute's aims and regulations is in preparation (*Nature*, 1950, 165, 903)

Indo-Pacific Fisheries Council

AT ITS SECOND ANNUAL MEETING at Cronulla (Australia) in April 1950, the Indo Pacific Fisheries Council elected Dr J D F Hardenberg of Indonesia as its Chairman and Dr A V Villaotolid of the Philippines as its Vice-Chairman for 1950-51 Technical committees and various *ad hoc* sub committees were set up to carry out investigations on Tunas neritic-pelagic group of fish, fish culture transplantation of fish, planktology hydrology, taxonomy and survey of fish industries in this region

One of the Council's major projects is the compilation of a register of the projects institutions, and personnel concerned with fisheries work in the Indo-Pacific region

Australian Journal of Marine & Freshwater Research

THE COMMONWEALTH SCIENTIFIC and Industrial Research Organization has decided to publish the *Australian Journal of Marine and Freshwater Research* as a medium for the publication of research papers on the results of original investigations on sea, estuarine and freshwater fisheries and cognate subjects It is expected that two issues of the journal will be published each year, each issue will cost 7*s* 6*d*

The New Publication — "Chemical Age"

"CHEMICAL AGE', SERIES I (TECHNICAL Press Publication Bombay, April 1950 Price Rs 10), is the first of a series of comprehensive biennial issues covering the chemical process industries of India The inaugural number features a wide range of review articles dealing with various developmental and technical aspects of the heavy chemical fine chemical, synthetics and fertilizer industries Special emphasis is laid on artificial manures and pesticides, both vital to the agricultural economy of the country

The articles are contributed by eminent scientists and writers — all specialists in their respective fields The annotated bibliographies, graphical flow sheets, production charts and abundant illustrations of plant and equipment have increased the usefulness of the volume

Board of Engineering Research

THE PRESIDENT INDIAN COUNCIL of Scientific & Industrial Research, has constituted a Board of Engineering Research to function as an Advisory Body to the Governing Body of the Council The following have been nominated to serve on the Board up to March 1953 Shri A N Khosla, Chairman Shri Kasturbhai Lalbhai Shri S Moolgaokar, Shri S L Malhotra, Shri Ramesh Chandra or alternately Shri J M Trehan, Shri F C Budhwar Shri Jang Bir Singh, Shri B S Puri, Dr S S Bhatnagar Shri G D Birla, Shri K D Jalan, Sardar Teja Singh Malik, Shri D V Joglekar Prof C A Hart, Prof M S Thacker, Prof A Viswanathan, Director, National Metallurgical Laboratory, Dr K S Krishnan and an engineer as Secretary

The Board's main functions will be to initiate and co-ordinate research work in various branches of engineering

Government of India to Purchase Uranium Stocks

THE GOVERNMENT OF INDIA HAVE decided to purchase all stocks of uranium available with dealers and mine-owners A minimum uranium content equivalent to 10 per cent by weight of uranium oxide is required in the ores or concentrates which will be paid for at a minimum rate of Rs 9 per lb of contained uranium oxide Uranium dealers and mine-owners should contact the Secretary, Atomic Energy Commission, Department of Scientific Research, New Delhi

Announcements

Prof P Maheshwari Head of the Department of Biology, Delhi University, has been elected Chairman of the Plant Embryology Section of the International Union of Biological Sciences for a period of five years Prof Maheshwari will prepare a directory of the scientific institutions and individuals carrying on research work in plant embryology and will also conduct a census of recent research in this field

Dr R C Sahney of the National Physical Laboratory, New Delhi, has been granted the 1851 Empire Exhibition Scholarship for 1950 The scholarship awarded to him is for research in Physical Chemistry at Cambridge University

The Lady Tata Memorial Trust have announced the following awards of Scholarships and Grants for the year 1950-51 on the occasion of the 1950 death anniversary of Lady Meherbai Dorabji Tata The International Awards totalling £3,000 for research in diseases of blood with special reference to Leucaemias are made to Dr Ed[illegible] Paterson (England), Dr Pasc[illegible] Atanasiu (France), Dr J Bich[illegible] (Denmark), Dr E Kelemen (Hungary) Dr Charles Oberling (France), Dr Günther Shallock (Germany), Dr Astrid Fagraeus and Dr Bo Thorell (jointly) (Sweden) Dr Niels M G Harboe (Denmark), Dr M Henri P L Febure (France) and Dr George Discombe (England)

Indian Scholarships of Rs 250 per month each for one year are awarded to Mr P R Srinivasan (Coonoor), Mr Siva Sankar (Madras), Dr Dharmendra, Dr Pal Singh (Agra), Dr Srinivasa Sriramacharyulu (Andhra) and Dr (Miss) Sunita Popatlal Bharani (Bombay).

INDIAN CENTRAL COTTON COMMITTEE

THE ANNUAL REPORT OF THE TECHNOLOGICAL Laboratory of the Indian Central Cotton Committee ending 31st May 1949 records steady progress in technological applied and fundamental research Some of the investigations completed during the year have been of direct benefit to the cotton breeder

One of the important items of work completed during the period under review relates to the estimation of spinning values of Indian cottons from a knowledge of their chief fibre properties Regression equations and correlation coefficients have been worked out for *G hirsutum G herbaceum L Var frutescens* (*Delile*) *H & G G arboreum Var neglectum forma indica* and *G arboreum Var neglectum forma bengalensis* By using these formulae a cotton breeder can now easily estimate the spinning value of any new strain with a fair degree of accuracy from its fibre properties The partial correlation coefficients have also been calculated to assess the relative importance of the fibre properties

Pre cleaning and ginning tests have been carried out on *Mathio* cotton with saw gin single roller gin and double roller gin and the lint obtained was tested for fibre length and spinning value Saw gin gave about 1 50 per cent lower ginning percentage than either single roller or double roller gin The power consumed in double roller gin was practically the same as that in the saw gin for an equal weight of seed cotton while in single roller gin it was about twice as much Yarns spun from samples ginned in the saw gin were on the average stronger than those spun from the other two gins An apparatus specially designed and calibrated in the laboratory was used for the purpose of determining the strength of attachment of fibres to the seed These studies showed that the strength of attachment of the fibres to the seed was very much greater at the micropylar end than those attached to other regions

A new gin suitable for small samples has been designed in the Laboratory This gin is of the Macarthy type having a roller length of 7" with a chain drive on ball bearings and is designed both for hand and for electrical drive The machine even in its wooden model has been found to be quite satisfactory and can conveniently be used in place of Platt s hand gin recommended in the standard ginning technique for small samples

Studies on the effect of agronomical factors on the fineness of cotton were completed during the year Ammonium sulphate applications have been found to lower the mean fibre length fibre maturity swollen wall thickness bundle strength and intrinsic strength Application of manure just before sowing proved more useful to fibre length 40 lb of nitrogen gave the highest bundle strength value when broadcast 3 weeks before sowing on high fertility soil On the whole doses of nitrogen over 20 lb are harmful to fibre properties

A systematic study of the incidence of structural deformities such as binds and spurs and apical ends on the standard Indian cottons was made Observations on the incidence of (i) hairiness of leaf bits found in raw cottons (ii) immature and insect attacked seeds in the *Kapas* and (iii) neps at various stages of yarn manufacture were included in the investigation A significant positive correlation between the percentage by weight of neps in the sliver and the number of neps per gm of the yarn counted according to either of the two methods shows that the quantity of neppy material taken out while preparing the sliver can be taken as an index of the neppiness of the cotton

A study on the causes of abnormal spinning performance in Indian cottons is being conducted at the Laboratory It has been found that the roving generally has a mean fibre length less than that of the raw cotton and possesses a greater fibre length irregularity percentage and is about 10 per cent stronger The decrease in length and regularity in the roving is pronounced in the case of Indian cottons whose staple length is about 0 93" and over

The use of polarized light for evolving a quick method of determining fibre maturity was investigated Under the polarized light the mature fibres appear yellow and green while the immature ones appear pink and blue Based on this observation an efficient and a quick method has been worked out

Routine and other tests were carried out on 1207 cotton yarn and cloth samples received from cotton breeders and the cotton trade and industry Comparative mill and laboratory tests were carried out on *Jayawant* and *Jaydhar* varieties as regards their mean fibre length and spinning performance The examination of the results obtained for the three seasons 1944-47 showed that *Jaydhar* yields distinctly stronger yarns than *Jayawant* in all localities The mill tests also gave the same result except in the case of Transition Tract and Eastern Tract Comparative tests on *Ladog* 1 and *Laxmi* (9 3) showed that *Laxmi* yields stronger yarns

Standard Indian cottons of the 1947 48 season were subjected to detailed fibre and spinning tests and a bulletin containing the results of these tests was published during the period under review Four cottons *Jayawant V* 434 (*Akola*) *Gaorani* 6 and *Cambodia* Co 32 showed an improvement over their performance of last season

IRRIGATION RESEARCH IN MADRAS

THE ACTIVITIES OF THE IRRIGATION RESEARCH Station Poondi Madras reviewed in its annual report for 1948 show considerable progress in a number of research projects investigated during the year The studies have contributed to increased efficiency in the design of works and considerable reduction in their cost has been effected

In river control studies experiments on a 1/150 scale model of the Godavari for testing the alignments of the cellular dams for the Rampadasagar Project were pursued with a tilted bed and data obtained for application to bed movement in the proto-type A large number of anicuts was designed and tested Novel features were introduced in these designs with a view to increase their efficiency in performance and economy in construction Savings of Rs 12 000 and Rs 20 000 were effected on the Shambipettai odai and Uttiramerur anicuts respectively Another saving of nearly a lakh of rupees was made on the Jedarpalayam anicut The design of stilling basins with one or two rows of floor blocks and with or without buttresses evolved at the station has proved very efficient as a dissipating arrangement for a spillway dam Adjustability to variations in discharge and tail water levels to a very wide range is particularly satisfactory in this design Considerable extension of irrigated area was effected by remodelling the existing sluices so as to increase the discharge drawn through them As a result of tests on earth dam models a large portion of the Lower Bhavani Dam originally proposed to be constructed in masonry is now proposed to be constructed in earth The reduction in cost due to this change-over is likely to be of the order of Rs 50 lakhs

Studies conducted on building materials and construction led to the adoption of cheap and easily provided substitutes in place of the conventional materials that have become costly and difficult to procure Soil cement blocks cement concrete slates and tiles reinforced cement concrete frames for doors and roof trusses etc have been satisfactorily used for many buildings in the project camps with great economy

SCIENTIFIC ACTIVITIES OF THE NATIONAL METALLURGICAL LABORATORY

A FEW OF THE PROBLEMS UNDER INVESTIGATION IN the National Metallurgical Laboratory are Electrolytic polishing and etching of ferrous and non ferrous metals and alloys and the detection of temper brittleness a study of austenitic grain size control of nickel chrome high alloy steels anodizing of aluminium and its alloys and the production of titanium tetrachloride from Indian ilmenite The characteristics of Indian moulding sands are being studied

Experiments carried out to convert low grade manganese ores (from Madhya Pradesh) into manganese sulphate have yielded encouraging results Attempts have been made to prepare electrolytic manganese and high purity manganese dioxide from manganese sulphate

A scheme on the production of beryllium from beryl on pilot plant scale based on a process developed by the *Beryllium Corporation* has been prepared

Investigations have been carried out on the corrosion of stainless steels in solutions containing nitric and sulphuric acids electrolytic recovery of nickel from silver refinery waste and electro-refining of copper from cuprous chloride solutions

The Refractories Division has initiated investigations on the production of sillimanite zircon and carbon refractories Preparation of carbon electrodes is also being investigated

Work on the measurement of wear resistance of steels under varying service conditions will be undertaken shortly Preliminary work on the production of iron aluminium-cobalt sintered magnets by the powder metallurgy method is in progress For this purpose experiments are being conducted for preparing an iron aluminium master alloy by the sinter method

Ore dressing Laboratory problems under investigation are (i) separation of cryolite from carbon dust produced in the aluminium reduction furnaces at Jakaynagar (ii) concentration of ilmenite sands and (iii) beneficiation of low grade chrome ore from Dodkanya Mysore and other sources

DICTIONARY OF ECONOMIC PRODUCTS & INDUSTRIAL RESOURCES OF INDIA

THE FIRST VOLUME OF THIS ENCYCLOPAEDIA COVERING letters A and B which was published in January 1950 has been very favourably reviewed in many of the leading scientific journals of the world The second volume covering the letter C is now in the press and will be published in about a month Like the first volume it is divided into two parts one dealing with Raw Materials and the other with Industrial Products The raw materials volume consists of about 300 main articles including tea coffee coconut citrus cinchona coal and clay and is profusely illustrated with text illustrations and plates The part dealing with the industrial products is also profusely illustrated This part includes articles on canning cotton textiles ceramics coir etc

The Office of the Dictionary of Economic Products is now busily engaged in compiling articles for the third volume which will be published in 1951 In addition to the main work of compiling the Dictionary this office has been acting as a clearing house of scientific information on raw materials and industrial products of India

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for July 1950.

Paints, Varnishes & Lacquers

41456 Extraction of titania from titanium-bearing materials *Treating the raw material with sulphuric acid and a bivalent metal or its oxide or sulphate and thereafter igniting the double sulphate to obtain titania therefrom* — Mehta & Patel

41457 Titanium pigments *Double sulphate of titanium and of a bivalent metal is treated with an alkali and thereafter calcined at 700°-800°C* — Mehta & Patel

Inorganic Chemicals

41005 & 41006 Sodium bicarbonate *Adding* 0 1 *to* 2 *per cent of very finely powdered calcium hydroxy phosphate or basic magnesium carbonate to sodium bicarbonate powder Adding* 0 1 *to* 2 *per cent of potato starch powder to sodium carbonate powder* — I C I Ltd

41755. Method of extracting potassium from dilute solutions *Precipitating potassium aminate with a suspension of highly nitrated secondary aromatic free amine in presence of a base capable of forming soluble salt with the amine* — Norsk Hydro-Elektrisk Kvaelstofaktieselskab

42886 Manufacture of manganous sulphate *By heating pyrolusite with iron pyrites* — Moorthy, Datar & Zaheer

Metals & Metal Products

41821. Manufacture of cast irons *Cast iron with boron and aluminium as alloying elements* — Singh

42221 Treating ores bearing chromium or titanium *Establishing and maintaining a bed of material containing iron compound with titanium or chromium oxide in finely divided condition and passing gases containing chlorine and carbon monoxide* — The Dorr Co

43046 Manufacture of cast irons with improved nodular structure and malleable characteristics *Molten cast iron containing magnesium, nickel and/or copper* — Singh

41838. Distillation of aluminium from aluminium-bearing material *Including the circulation of the halide vapour in the system by the use of an injector* — International Alloys Ltd

43095 Desulphurization of metals and alloys by silicon *Desulphurising by heating at reduced pressure with silicon* — Electric Furnace Products Co Ltd

Rubber & Rubber Products

42672 A process for spinning solutions of natural rubber *Solution of rubber plasticized to standard viscosity lower than* 10 *poises in toluene is used for obtaining threads in a bath saturated with* SO_2 — N V Onderzoekingsintituut Research

Stone, Clay & Glass Products

41342. Foam glass *Powdered glass consists of glass powder of comparatively large grain size to which has been added fine grain glass powder* — Ram, Varshney, Rao & Sharma

42403 Grinding of granulated slag or similar materials · *Feeding a grinding mill with variable specific gravity and hardness without previous homogenisation* — Trief & Trief

Miscellaneous

42441 Treatment of tars and pitches *Dissolving in volatile solvent separating solid from liquid, removing solvent from filtrate, again distilling the secondary tar and repeating the whole process with the residual secondary pitch* — C D. Patents Ltd

42450 Manufacture of moulded carbon articles from pitch *"Free carbon" obtained from pitch by treating with a solvent is moulded and fired to 550°C in a non-oxidising atmosphere* — C. D Patents Ltd

42760. Converting a petrol-operated internal combustion engine into a kerosine oil-operated engine *Combustion air and fuel independently preheated by exhaust of engine before entering carburettor, air heating chamber has pipes heated by the exhaust, fuel heated by contact with surfaces of fuel-heating chamber heated by the exhaust* — Bhargava

PATENTED INVENTIONS OF THE C.S.I.R. — *Continued from page 348*

No. 39427

B. B. Dey, R. K. Maller & B R. Pai

2, 4-Diaminophenol is obtained by the electrolytic reduction of 2, 4-dinitrophenol in strong sulphuric acid at 118°C. in an yield of 94·4 per cent. No attempt appears to have been made to reduce 2, 4-dinitrophenol in dilute sulphuric acid at a lower temperature and obtain the compound in good yields.

According to this process, by electrolysing an emulsion of 2, 4-dinitrophenol in 30 per cent sulphuric acid at a copper cathode, in the absence of a catalyst at a current density of 1·99 amp /sq dm and 90°C., 2, 4-diaminophenol has been obtained in a pure condition (as the sulphate) in 81 per cent yield.

Patented Inventions of the Council of Scientific & Industrial Research

COMPOSITION FOR THE MANUFACTURE OF PATENT LEATHER

No 38063

U S A & British Patents pending

S SIDDIQUI & D C DHAR

A SUITABLE AND ECONOMICAL COMPOSITION FOR the manufacture of patent leather has been prepared from easily available and as far as possible indigenous ingredients An oil resin is first prepared as described in patent No 38064 by copolymerizing vegetable oils with bhilawan shell liquid and turpentine or rosin (or like oleoresinous materials) by treatment with nitric acid the said oil resin is dissolved along with film scraps in butyl acetate and solvent naphtha The ingredients are mixed by vigorous agitation in a shaking machine

In respect of successive coatings variations may be made in the ingredients as illustrated below

(a) The following further ingredients are added to constitute the first coating composition butanol or fusel oil methanol turpentine and dibutyl phthalate

(b) the following further ingredients are added to the first coating composition to constitute the second coating composition bhilawan enamel castor oil

(c) the third coating composition is composed of butyl acetate butanol or fusel oil methanol solvent naphtha film scraps dibutyl phthalate and acetone

The proportions of the various ingredients are described in the patent Bhilawan enamel is added to the composition for obtaining a fine glossy jet black film

The coating compositions are applied to leather (preferably chrome tanned) in the manner widely known in patent leather trades

CONVERSION OF BHILAWAN SHELL LIQUID

No 40752

S SIDDIQUI K K SARIN & A SINGH

THE INVENTION RELATES TO THE CONVERSION OF bhilawan shell liquid to a non vesicating drying product for the manufacture of lacquer varnishes stoving enamels or water resistant and flame resistant paints It consists in treating bhilawan shell liquid with chlorine until the chlorination has proceeded at least up to 25 to 30 per cent

The chlorine treatment is carried out in a solvent medium such as kerosene or white spirit at temperatures ranging from 30° to 70°C After chlorination the solvent is partially driven off by heating the chlorinated product at temperatures between 80° and 100°C The chlorine treated product which is a viscous mass at this stage is converted to a non vesicating semi solid to solid drying resin on removal of the solvent excess chlorine and hydrochloric acid formed during the reaction at temperatures ranging up to 150°C This resin which has chlorine content up to 55 per cent by weight is soluble in benzene turpentine or the like hydrocarbon solvents For the manufacture of paints pigments such as zinc carbonate and magnesium carbonate are worked into the varnish The paint is applied by brushing or spraying to fibres fabric or like materials to render them water resistant and flame resistant

PRODUCTION OF 2, 4-DIAMINOPHENOL

No 35328

R B DEY T R GOVINDACHARI & H V UDUPA

2 4 DIAMINOPHENOL SALTS ARE USED EXTENSIVELY as photographic developers The chemical is commonly prepared by reducing 2 4-dinitrophenol with a metal and acid or electrolytically It has also been obtained by the direct reduction of *meta* dinitrobenzene or *meta* nitraniline in concentrated sulphuric acid electrolytically In the present invention the substance is produced by the electrolytic reduction of *meta* dinitrobenzene in dilute acid emulsion

Example — 40 gm *meta* dinitrobenzene 400 c c of sulphuric acid of 40 per cent strength 1 gm mercuric sulphate at copper cathode current density 7 amp /sq dm temperature 95°C gave 24 4 gm of 2 4 diaminophenol oxalate (48 per cent yield)

No 37566

B B DEY H V UDUPA & B R PAI

In the present patent 2 4-diaminophenol is produced by the electrolytic reduction of *m* nitraniline in dilute sulphuric acid emulsion By electrolysing a solution of *m* nitraniline in 30 per cent sulphuric acid at a monel cathode using 0 2 gm of mercuric sulphate for every 400 c c of the sulphuric acid at a current density of 2 3 amp /sq dm and 80°C 2 4-diaminophenol has been obtained in 50 per cent yield The 2 4-diaminophenol is first isolated as the sulphate and then in a pure condition as the oxalate

No 39426

B B DEY R K MALLER B R PAI & H V UDUPA

The yield of 2 4-diaminophenol is improved by the reduction of *m* nitraniline in dilute sulphuric acid solution at a copper cathode in the presence of copper sulphate

Example — By electrolysing a solution of *m* nitraniline in 40 per cent sulphuric acid at a copper cathode using 1·0 gm of copper sulphate for every 400 c c of the sulphuric acid at a current density of 1 0 amp /sq dm and 80°C 2 4-diaminophenol has been obtained in 69 per cent yield

Continued on page 347

The Central Road Research Institute

THE laying of the foundation-stone of the Central Road Research Institute on September 6,1950, at Delhi, by the Hon'ble Shri N Gopalaswami Ayyangar, Minister for Transport, Government of India, is yet another landmark in the great constructive work of " bringing into existence large-scale laboratories and institutes for the promotion of scientific research and its application to industry and to the betterment of human life ", initiated and pursued by Dr Shanti Swarup Bhatnagar with such conspicuous success The need for a central organization for the study of soils in relation to road construction was first mooted by the Indian Roads Congress in 1943, but the proposal to establish a Central Road Research Institute, covering all aspects of road construction and maintenance, emerged in 1944 as a recommendation of the Industrial Research Planning Committee of the *Council of Scientific & Industrial Research* The Governing Body of the *Council* accepted the recommendation in 1945 and appointed a Committee to work out the details

The importance of good road communications to a country, both for economic progress and defence, is now widely recognized, but the vital rôle of scientific research in the making and maintenance of roads and the magnitude and the economic significance of road research do not appear to have been so widely appreciated The Hon'ble Shri N Gopalaswami Ayyangar observed in this context " Like all things connected with all forms of communications, there has been a revolution in ideas, technique, policy and action The study of soil conditions is now recognized to be a necessary preliminary to the designing of foundations and embankments on which roads could be built The requirements of effective drainage call for careful investigation The materials for surfacing roads and the methods of soiling, binding, rolling and carpeting require knowledge, experience and intelligence There have been very rapid developments in the kind, weight and speed of fast-moving road traffic , and the relating of the strength and durability of the road surface to such traffic is among the major problems of road construction and maintenance Above all, due to these and other reasons, the public have come to demand a progressively higher standard of road maintenance We have, therefore, reached a stage when we can no longer avoid or delay an organized scientific approach to the satisfactory solution of what is an intensely practical human problem "

The total length of roads of all kinds in India is 3 5 lakh miles According to the Indian Roads Congress, India should have an additional 4 lakh miles of roads including approximately 25,000 miles of national highways and trails, 65,000 miles of provincial highways, 60,000 miles of major district roads, 1 lakh miles of other district roads and 1 5 lakh miles of village roads The cost of constructing tarred roads is about Rs 30,000 per 10-ft wide mile, Rs 50,000 per mile of cement-concrete road, Rs 5,000 or more per mile of *kucha* road According to the estimates of the Planning Commission, 1,159 crores of rupees are to be spent on transport development schemes in India The implementation of this plan of road construction calls for the expenditure of huge amounts of money and material, and if, as a result of research, it is possible to reduce the cost of construction and maintenance by even 1 per cent, the saving effected would amount to a few crores of rupees

It is obvious that a good road must be solid, and that it should withstand the effects of traffic as well as those of climate The construction of such solid roads in the most economical way is one of the aims of road research Yet economy does not only depend on the cost of construction, but also on the durability of the road Both good construction and efficient maintenance postpone the need for repairs or expensive reconstruction If one considers the enormous sums of public funds that yearly go into roads, it would be in the interests of national economy to ascertain, even from the beginning, the optimum conditions for constructing " the solidest and safest roads using the natural and most economical methods "

Road-making and road maintenance are intensely practical problems, and research of a purely scientific character, which is both necessary and important, has to be carried out in the closest collaboration with engineers in the field The raw material resources have to be investigated collectively and on a regional basis, the requirements of various tracts and regions have to be determined and assessed, and the results of research carried out in the laboratory and in the field, both at the Institute and at other stations, have to be co-ordinated It was emphasized by the Hon'ble Shri N Gopalaswami Ayyangar that "research, before it can be held to be complete, will have to pass at least three stages There is, first, purely scientific work in the laboratory The results of this work have, in most cases, to be tried out first in working models There has then to be the field test It is only when all the stages have been successfully passed through that large-scale construction work on the roads embodying the results of the research could be put in hand There has to be very close liaison between engineers and scientists at all the three stages, in the laboratory when the engineer states the problem for which he requires a solution, at trials on the working models and, during the field tests, the assistance of the engineer will be necessary in ensuring that the natural conditions are reproduced there as fully as possible "

The special requirements of road research have been fully examined and taken into account in planning the work of the Institute in its various divisions The Central Institute will work in close co-operation with regional stations like those at Madras, Patna, Karnal, Lucknow, Calcutta and Poona A Division of Economics and Statistics has been organized and results of research will be proved and tested before they are recommended for adoption in the field The Institute will undertake investigations on the properties of materials of construction, their testing and standardization, the characteristics of roads under different traffic conditions, incidence of accidents, road safety, and road statistics Recently work on road building and surfacing materials has been made in the temporary laboratories erected at the site, and significant results have already emerged

The Institute is fortunate in securing the services of Dr Ernst Zipkes, distinguished for his many original contributions to the scientific and engineering aspects of road construction and maintenance Dr R K N Iyengar, Assistant Director (Planning), has been largely responsible for drawing up detailed plans for the Institute. Dr Zipkes, Dr Iyengar and their colleagues have before them vast opportunities for constructive work All men of goodwill will join the Hon'ble Shri N Gopalaswamy Ayyangar in wishing the Central Road Research Institute " an unbroken career of increasing usefulness to the country of which we are proud to be citizens "

North-east Assam Earthquake of 15th August 1950

D N WADIA

NORTH India, more precisely extra-peninsular India, has been visited by a succession of disastrous earthquakes within historic times It is a well-authenticated generalization that the majority of the Indian earthquakes have originated from the great plains of India or from their peripheral tracts, mostly the northern border, which has been a region of great seismic sensitivity This area is a zone of weakness and strain implied by the severe crumpling of the rock-beds in the uplift of the great pile of the Himalayas within recent geological times, and which have not yet attained stability or quiescence In the Assam region, the geological instability is largely due to the occurrence of two great fault lines, one along the foot of the Himalayas and the other passing from south of Shillong plateau to beyond the Patkoi range Minor slippings or dislocations along these faults are believed to have occasioned the great Assam earthquake of 1897 as well as the present quake Compared with the disaster of 1897, the present quake seems to be of lesser violence and intensity Then, Shillong and the surrounding country of 1,50,000 square miles with many populous cities were laid waste in a minute, all the communications destroyed, the plains riddled with rents and flooded and the hillside scarred by gigantic landslides The total disturbed area bounded by the isoseismal of V was not less than 16,00,000 square miles[1] In the present earthquake the area severely shaken is comparatively much less, being largely restricted to Lakhimpur district and area further north-east

Up to now no accurate data are available from seismographic records to enable us to fix the epicentre, or epicentres, in case there are two foci, as in the case of the Bihar earthquake of 1934 From such data as are available, the area surrounding the Lakhimpur district, about a thousand to 1,200 square miles, may be an epifocal tract Possibly the main epicentre lies without the borders of the Assam Valley, in barren uninhabited mountainous tracts from which the Brahmaputra, the Dihang and tributaries of the Salween have cut out deep canon-like valleys This inference is supported by the havoc wrought by floods which have swept successively the rivers of upper Assam, caused by landslides interrupting normal drainage and creating temporary lakes bursting their dams one after the other Changes in topography, ground movements and relative level of the land, usual accompaniments of great tectonic quakes, will only be apparent when proper ground surveys have been made But such relative rise or subsidence of tracts is generally of a minor nature, the differential movements being rarely as much as 30-40 feet Fissures and rents in the ground erupting water and sand, with occasional gases (sometimes inflammable), are common features of such earthquakes, though their significance is often exaggerated The more gaping fissures in the 1934 Bihar earthquake were usually not more than 20 feet in width, the majority being about a foot in width and rarely more than 40 or 50 feet in depth[2] Their length may vary from a hundred yards to about half a mile at most Much of the devastation caused by the earthquake of 15th August is really to be ascribed to subsidiary effects, felt long after the passage of the seismic wave, and not to the actual violence of the earth tremors It is possible that a few permanent changes may be noticed in the tributaries of the Brahmaputra, e g in the shifting of their courses, creation of new lakes, etc Sounds accompanying great earthquakes are usual features These have been variously described as booming of guns, passage of express trains or heavy motor vehicles, heard by many people during or immediately after the passage of earthquake These are caused by sound-waves generated by the undulatory motion of seismic wave as it sweeps along the earth's surface

It is certain that the present earthquake is of the " tectonic " type, connected with the structural weakness in the underground rock framework and not at all connected with any volcanic eruption There are no living or dormant volcanoes within hundreds of miles of Assam, the nearest volcanoes being the Popa and Narkondam cones of Burma and the " Barren Island " Volcano of the Bay of Bengal Reports and tales of mythical volcanoes in Tibet having been observed in actual eruption by travellers are not substantiated The emission of sulphurous vapours and inflammable hydrocarbon gases from some of the ground fissures has evidently led to stories of volcanic outbursts Such gaseous emissions are entirely superficial and have not even a distant connection with volcanic phenomena Earthquakes of valcanic origin are, moreover, local in their effect and do not shake an area of thousands of square miles

The most usual feature of violent tectonic quakes is aftershocks, which may number hundreds, or even thousands, felt in the epifocal tract and may last for months if not a year These aftershocks are of gradually decreasing intensity and may show shifting foci Though these aftershocks cause panic and may further intensify the damage caused by the initial shocks, their occurrence is to be welcomed, as they indicate gradual relief of strain and the settling down of rocks before held under tension

Science has yet no means of forecasting or fore-warning of impending earthquakes and the only protection man has against this natural calamity is building of earthquake-proof structures which minimize the damage to life and property

Further data for study of this earthquake are to be awaited till the usual *Memoir* on the subject is published by the Geological Survey of India — the distribution, duration and severity of the shocks, their direction and focus of origin, the effects on topography, hydrography, agriculture and other works of man, seismometric records from Indian and extra-Indian stations, isoseismals of different intensities and carefully compiled lists of aftershocks

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1 " The Great Earthquake of 12th June 1897 ", R D OLDHAM *Memoir*, Vol XXIX, *Goel Surv India*, 1900

2 " The Bihar-Nepal Earthquake of 1934 with Seismometric Study ", *Memoir*, Vol LXXIII, *Geol Surv India*, 1939

Characteristics of the Ionosphere over Calcutta (July 1950)

S S BARAL, R K MITRA, D C CHOUDHURY, A P MITRA & R B BANERJEE

Ionosphere Laboratory, Institute of Radio Physics & Electronics, Calcutta

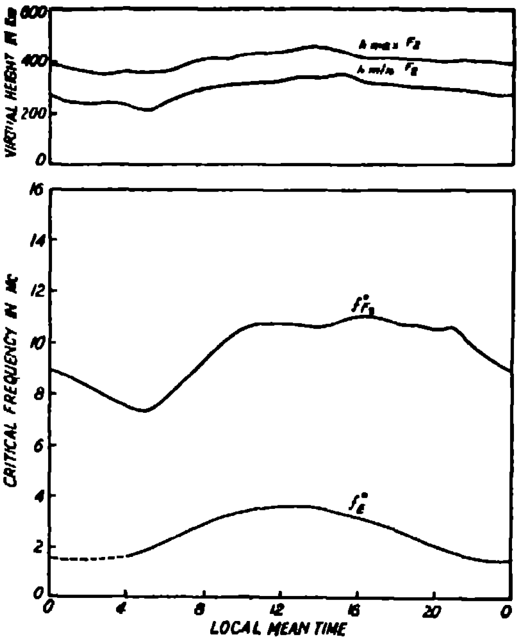
THE following are the ionospheric data observed at Calcutta for the month of July 1950

The mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 are represented in Fig 1 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of October 1950 Table I records the various occasions during routine observations when sporadic E ionization was observed and the corresponding values of penetration frequencies and heights

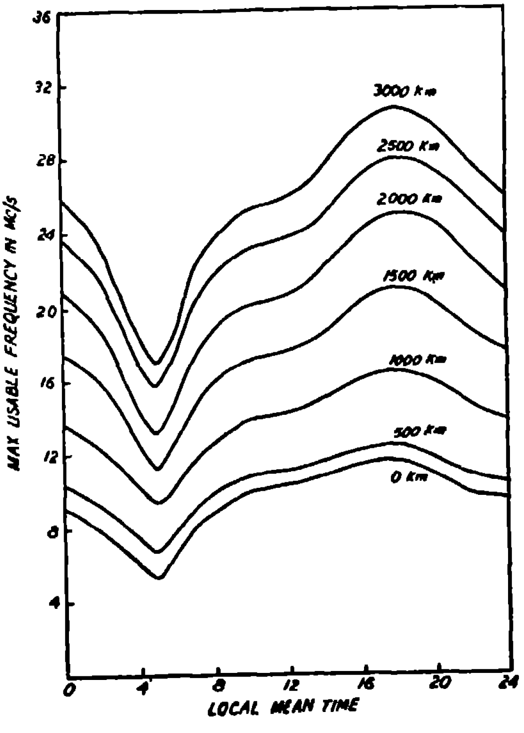
Sporadic E ionization was found to occur frequently during evening and at night and sometimes during the afternoon Sporadic E ionization occurred more frequently during night than during day in the present month Region F_2 ionization was found to remain steady up to late afternoon

TABLE I

MONTH & YEAR	DATE	HOURS L.M T	$f^o F_s$ Mc.	h_{F_s} Km.
July 1950	6	14 00	7 80	150
		16 00	6 65	135
	7	13 00	8 00	150
		14 00	8 00	150
		15 00	7 20	135
	8	09 00	6 15	120
		10 00	6 70	120
		11 00	7 00	135
	10	13 00	8 00	150
		14 00	8 00	150
	11	13 00	7 10	135
		18 00	5 50	135
		19 00	5 50	120
		20 00	4 00	105
	12	20 00	6 10	105
		22.00	5 40	105
	13	18 00	3 50	90
		19 00	3 50	90
		20 00	3 20	90
	18	16 00	3 40	120
		17 00	3 00	105
		19 00	2 75	105
	19	20 00	2 50	90
	20	10 00	7 00	120
	21	16 00	7 80	135
		17 00	7 00	120
		18 00	6 75	120
		19 00	5 00	120
		21 00	3 00	105
		22.00	4 00	105
	24	16 00	6 50	120
		17 00	6 00	120
		19 00	5 00	105
		20 00	3 50	105
	26	17 00	4 00	105
		18 00	3 50	105
		19 00	4 00	105
		20 00	3 20	90
		21 00	3 00	90
	27	15 00	4 40	120
		16.00	4 00	120
		18 00	5 00	105
		19.00	4 80	105
		20.00	3 40	105
	28	17 00	3 50	105
		18.00	5 00	105
		19 00	4 30	105
	31	18.00	6 50	135
		19 00	5 80	120
		20 00	5 00	120
		21 00	3 30	105



(5 HR 54 MIN AHEAD OF G M T)
FIG 1 — JULY 1950



AT POINT OF REFLECTION
FIG 2 - PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF OCTOBER 1950

The Central Glass & Ceramic Research Institute, Calcutta, Opening Ceremony, August 26, 1950

THE Central Glass & Ceramic Research Institute, Calcutta, was declared open by the Hon'ble Dr B C Roy, Chief Minister, West Bengal, on August 26, in the presence of a distinguished gathering of scientists, representatives of the glass and ceramic industry, officials of the Central and State Governments and prominent citizens of Calcutta His Excellency Dr Kailas Nath Katju, Governor of West Bengal, presided over the ceremony

Fourth in the chain of National Laboratories to be declared open this year, the Central Glass & Ceramic Research Institute satisfies a long-felt need Since the time of the Industrial Commission, 1918, the need for setting up a research institute was stressed by a succession of Tariff Boards, leaders of science and industry and scientific organizations For the development of the Indian glass industry, two primary requirements were considered essential trained workers, and scientific knowledge relating to materials, processes and techniques Thanks to the efforts of the *Paisa Fund Glass Works* at Talegaon near Poona, a large number of skilled workers were trained and made available to the industry This was of considerable assistance to the industry in the early stages of its development Facilities for research and investigation and for training glass technologists, vital to the progress of the industry, were not so far available, and these have now been provided in an adequate measure by the new Institute, which owes its establishment to the zeal, foresight and energetic leadership of Dr Shanti Swarup Bhatnagar, who initiated this project in 1942 and took measures necessary for its completion

Dr Shanti Swarup Bhatnagar, in his address, referred briefly to the developments which led to the establishment of the Institute He had received considerable encouragement in the work connected with this project from Dr B C Roy, Chief Minister of West Bengal, the late Mr K C Roy, Secretary, College of Engineering and Technology, Jadavpore, and Dr Meghnad Saha He paid a warm tribute to the work of Dr Atma Ram who, as Planning Officer and subsequently as Joint Director, contributed that zeal, industry and vision to the project which provided Calcutta "with a modern palace of glass — a real thing of beauty, which will instil inspiration in industry taking to scientific techniques of manufacture, and which will inspire our young men to contribute their mite to the success and progress of Indian industry"

Situated on a spacious site on the Gariahat Road, close to the Jadavpore Technical College, the Central Glass & Ceramic

DR ATMA RAM, JOINT DIRECTOR, CENTRAL GLASS & CERAMIC RESEARCH INSTITUTE

Research Institute, with its imposing tower, is a carefully designed and well-equipped laboratory providing facilities for team work and for specialized research in glass and ceramics It consists of two blocks, the Main Block comprising laboratories for precision work, the library and the museum, and the Technological Block comprising units for processing raw materials, furnaces and workshops This imposing structure has many notable features Special mention may be made of the glass doors made of bullet-proof armoured plates The vestibule is decorated with a mural in cut glass depicting the glass blower's craft and an enamelled panel bearing the Council's insignia and the inspiring words of Pandit Jawaharlal Nehru "Do it now! I am not interested in excuses for delays I am interested only in things done" The museum, the entrances of which are curtained by artistic glass fabrics, houses, besides the raw materials and the finished products of the glass and ceramic industries, many rare exhibits of historic interest Excavated pieces of ancient Indian art from Mohenjodaro and Harappa, glass articles of the Moghul, Napoleonic, pre-Victorian and Victorian periods, specimens of the historic articles from Westminster Abbey Switzerland, France and Sweden provide an array of exhibits spanning the long stretch of man's evolutionary history Of special interest to the man of science are a double-ended discharge tube belonging to de la Rive, a Woulfe's bottle used by Davy and Faraday, an original heavy glass prism made by Faraday, porcelain prisms, glass and semi-cylinders employed by Sir J C Bose in his investigations and a desiccator, a stone bottle and measuring cylinder belonging to Sir P C Ray A specimen of glass produced by the first atomic bomb explosion at New Mexico has been presented to the museum by Chancellor Arthur Compton of U S A

DR B C ROY, CHIEF MINISTER OF WEST BENGAL, OPENING THE CENTRAL GLASS AND CERAMIC RESEARCH INSTITUTE

The subjects of study at the Institute include glass, pottery, porcelain, enamels, glazes, abrasives and refractories Its functions will be to conduct fundamental research having a bearing on different aspects of glass and ceramics, testing and standardization of raw materials and finished products and dissemination of technical information Special provision has been made for rendering technical assistance to industry for improving the quality of glass and ceramic products and to induce industry to adopt improved techniques of manufacture Even during the incubation period, the Institute has carried out a large number of investigations for improving the quality of raw materials by such treatments as washing and magnetic separation Researches on coloured glass, sintered glass and foam glass, are in progress The work on foam glass is of particular significance as the product possesses thermal isolation and buoyancy and is expected to find use as a building material It is proposed to put up a pilot plant to study the commercial aspects of foam glass production With the limited facilities of staff and equipment so far available, the Institute has been rendering technical assistance to industry with regard to raw materials, processes and techniques and giving advice on plant lay-out, furnaces, etc The work of analyses of raw materials and the testing of articles for serviceability is well organized and samples for examination and report are being regularly received The Institute is equipped with a modern workshop and several items of equipment now in use have been designed and fabricated by the staff in the workshop A sand washing plant of about ¼ ton per hour capacity and a percolator for treating casting slips have been presented to the Institute by *Messrs Hardy & Padmore* and *Messrs Rapid Magnetting Machine Co* A section for making refractory parts has been organized and it is proposed to conduct trials on slip casting of pots required in the manufacture of optical glass The Institute has been assisting the Indian Standards Institution in preparing standards for glass and ceramic products

Declaring the Institute open, the Hon'ble Dr B C Roy stressed the rôle of research in the development of the Indian glass and ceramic industry and the rôle of the Institute in improving the range and quality of products manufactured in India He said " It is not only necessary that the Institute should be well established in properly cons-

DR S S BHATNAGAR, DIRECTOR, COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH, ADDRESSING THE GATHERING

Dr B C Roy delivering his address at the opening ceremony of the Central Glass & Ceramic Research Institute.

tructed building and equipped with all the necessary paraphernalia, but it is also essential that it should be manned by the type of persons who would create enthusiasm amongst the trainees and confidence in those who would be benefited by the results of research Dr Atma Ram and his associates have established a reputation and I hope and trust that this Institute will have a succession of achievements to its credit "

In his message, which was read on the occasion by the Hon'ble Sri Hare Krushna Mahtab, Pandit Nehru referred to the scientific developments in the country during the past two or three years and pointed out "it may be said with truth that we have laid, during this period, the foundations of scientific research on a firm basis If these foundations are built upon properly and in the right spirit, I have no doubt that they will bear rich fruit in India " He hoped that the Institute will play an important rôle in developing not only the glass industry in India, but many of its ramifications, and nurture and spread the spirit of science

There are at present 80 glass factories and 40 pottery works distributed all over the Indian sub-continent A large majority of these are small concerns and the total value of their production is 3 to 4 crores of rupees These industries provide employment to about 1,00,000 workers Abundant raw materials required by the industry are available in the country, but the quality of the indigenous products is not uniformly satisfactory India imports annually nearly Rs 2 crores worth of glassware and Rs 70 lakhs worth of chinaware and porcelain The demand for imported goods is on the increase, and when in 1948 the Open General Licence was in force, the imports of glass and ceramic articles rose to Rs 3 67 crores

This serves as a pointer to the need for improving the standard of indigenous production No improvement is possible without a clear understanding of the science and technology of glass manufacture and the activities of the new Institute would provide that understanding which would enable the industry not only to hold its own against foreign competition but also to make substantial new advances

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Outbreak of a Fresh Cycle of the Desert Locust

HEM SINGH PRUTHI
Director, Locust Control & Plant Protection Adviser to the Government of India, New Delhi

BEFORE describing the initiation of a fresh locust cycle in 1949, a brief account of the history of the previous locust outbreaks and main features in locust biology should be of interest There are about half a dozen species of locusts found in the world of which three occur in India, of these, the Desert locust,* *Schistocerca gregaria* Forskal, is the most important India, like some other countries, has been, from times immemorial, subject to periodical visitations of locust swarms Comparatively authentic records of locust swarms are available only since the beginning of the nineteenth century Outbreaks occurred in 1812, 1821, 1834, 1843, 1863, 1869, 1878, 1889 and 1896-97 In the present century, the locust was active during 1901-3, 1906-7, 1912-15, 1926-31 and 1940-46 Thus there is a certain amount of periodicity in locust outbreaks when swarms appear and cause incalculable damage and destruction to crops, resulting sometimes in severe famines Due to lack of fodder and pasture, there is also heavy mortality among cattle, goats and sheep and sometimes people have to leave their homes in search of livelihood elsewhere During the 1926-31 cycle, which was of moderate intensity, direct losses to crops alone amounted to about 10 crores of rupees in spite of some expensive control measures undertaken In view of India's food position, the locust epidemic at this juncture is full of evil potentialities

Generally locust invasions are confined to north-western India, but in some years the swarms spread as far as Bengal and Assam in the east and Madras in the south The Desert locust is, however, an international pest The areas where this locust remains and breeds permanently lie in a vast desert tract, extending from Hissar district of the Punjab and Rajasthan in India, through Pakistan, the Middle East countries, eastern Africa, Sudan and up to the west coast of Africa Investigations carried out in India for about eight years (1931-39) under the *Indian Council of Agricultural Research* have shown that permanent breeding grounds of this locust on the Indian continent are mostly in the sandy regions of Hissar, Rajasthan, Cutch, etc, in India proper, Thar district of Sind, Khairpur Mirs and Bhawalpur States and the coastal areas of Lasbela and Baluchistan in Pakistan These otherwise dry and desert tracts become green with wild vegetation after rainfall and afford food to young locusts Generally the locust population is low and the general public and even the cultivators are hardly aware of it. When thus scattered about and rather inactive in movement, the locusts are said to be in the solitary phase However, if the rainfall is abundant in the permanent breeding grounds and other meteorological conditions are favourable, the locusts multiply very rapidly, giving rise to immense swarms which fly actively, leave their desert homes and invade not only the neighbouring parts of the country, but go into adjoining countries as well Locust swarms have been visiting all countries of southern Europe and U S S R , the major part of the African continent, all the Middle East countries, Afghanistan, etc The active phase of locusts in which they have the tendency to move in mass flights is the swarming or gregarious phase

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*The other two locusts are the Bombay locust and the Migratory locust

General Biology of the Locust

Phase Characteristics

The locust, like the common grasshopper, has three distinct stages in its life history (1) egg , (2) hopper — the young wingless individual, which hops about, and (3) adult or flier, when wings are fully developed

The freshly emerged fliers in the swarming phase are pinkish in colour After a fortnight or 3 weeks (during late spring and summer), they become sexually mature, when they assume a distinct yellow colour The adult locusts of the solitary phase are grey and become only slightly yellow when mature

The adult locusts, though active during the day, do not usually fly during the night and on cloudy days After sunset they settle down on crops and trees and feed on them Most of the damage is thus caused between dusk and morning

The female lays eggs in moist, sandy or sandy loam after drilling a 3" to 6" deep hole with its abdomen Hot and moist conditions are necessary for egg-laying Eggs are not laid during winter and the adult locust over-winter and lay eggs in spring During her lifetime, a female can lay as many as eleven clusters, each containing 60 to 120 eggs, at an interval of about one week, so that the total number of eggs laid by a female may be about 800 The rate of mortality at the egg and hopper stage is low In fact there are very few natural enemies or diseases which effectively keep down the locust population

The eggs resemble rice grains in size and shape They hatch in about 10 to 14 days in summer and in 3 to 4 weeks in spring and autumn, depending on soil temperature and moisture content The hopper or wingless stage lasts from 6 to 8 weeks in spring and about 5 weeks during summer depending on the prevailing temperature and humidity conditions

The characteristics of the two phases of the locust may be briefly described In general, the colour of the hoppers in the gregarious phase is black in early stages but later on it turns yellow or pinkish with distinct black markings The solitary hoppers are generally green but vary in colour depending on the colour of the surrounding vegetation For example, on "booh" (*Arena javanica*) the solitary hoppers assume an ashy hue and those found on "bajri" (*Pennisetum typhoideum*) or "wekra" (*Indigofera cardifolia*) are green The colour of the freshly developed adults or fliers in the gregarious phase is pink, gradually turning to grey and finally yellow when sexually mature, unless they get scattered The adults of the solitary phase remain grey even when sexually mature, but when they get crowded the colour turns yellowish

There are three important anatomical features which distinguish the two phases In the gregarious phase the ratio between the length of elytra and that of hind femur is over 2 15 , in the solitary phase this ratio is about 2 05 In the intermediate specimens, the ratio varies between the two limits There are invariably 6 eye-stripes in the gregarious phase, whereas they are generally 7, sometimes 6 and rarely 8 in the solitary phase Similarly, whereas in the gregarious phase the number of antennal segments is 26, in the solitary phase it is 27 to 30

Breeding Seasons & Swarm Migration

Locust breeding depends very much on rainfall as the eggs are laid in sandy soils which have sufficient amount of moisture for proper incubation and hatching of eggs There are generally two breeding seasons during the year, namely the spring and monsoon In some countries in the locust belt the rainfall is received mostly during winter and early spring, e g in south-eastern Arabia, Red Sea coastal areas, southern Iran, Baluchistan, etc In such areas the locust breeds in the spring season and there may be one or two broods and generations For example, in Baluchistan breeding starts in January and again in April In India, Anglo-Egyptian Sudan, etc , where the rainfall is received mostly in the summer and monsoon seasons, locusts breed during these seasons However, when there is spring rainfall and the soil conditions are suitable for breeding, as is often the case in the Punjabs (P and I), breeding takes place during spring also, if swarms are present

The swarms produced during spring and early summer in the Middle East and Baluchistan (winter-rainfall countries) usually fly eastwards into Sind, Punjab, Rajasthan, Uttar Pradesh, etc , during May, June and July They are, however, mostly concentrated in Sind, Khairpur, Bhawalpur and Rajasthan In the wake of the monsoon rainfall these swarms of locusts lay eggs and breed up to about the middle of September and even October and November if the rainfall continues to be favourable and the temperature is fairly high as was the case in 1949 Thus, as in the spring and early summer period, there can be two generations during the monsoon and autumn Many of the new swarms, produced as a result of monsoon breeding, fly westward into Baluchistan, Persia, eastern Arabia, etc , where they breed again in the spring of the year following However, a number of swarms developed in Rajasthan, Sind, etc , also fly in the northern, eastern and southern directions and thus invade all parts of India and damage *kharif* crops over vast areas The swarms are yet not known to States beyond U P and Madhya Bharat and those going there eventually die off Some swarms may over-winter in northern India and when conditions are favourable in the next spring, they breed and damage *rabi* crops In the summer they are joined by migrants from Baluchistan and other spring breeding areas Thus the multiplication of swarms continues from season to season and year to year, the breeding becoming progressively more intense and extensive and thus the cycle gets into full swing When conditions either in the spring or monsoon breeding areas become unfavourable for active breeding, or there is heavy destruction of locusts in any zone, there is a decrease in the number and size of swarms and general decrease in the locust population Ultimately, when conditions become unfavourable for rapid breeding throughout a year, or control measures are successful both in spring and monsoon breeding areas, locusts get scattered and revert to the solitary phase. However, even in the solitary phase, locusts keep on breeding on a negligible scale and undergo seasonal migrations as scattered locusts When general ecological conditions for mass multiplication of locusts become again suitable in any part of the belt, the locust changes into the gregarious or swarming phase, and there is an outbreak of a fresh cycle

Swarming Phase in 1949

After the last cycle ended in India in 1946, no locusts of gregarious phase were noticed in this country and the population of solitary individuals also remained low for about two years However, there were fluctuations in their population because of seasonal migration of locusts from western countries, viz Baluchistan, Persia, east Arabia, etc , into India from May onwards and their emigration in the opposite directions in the autumn

After a lull in locust activity during 1947 and 1948, gregarious breeding took place in some parts of east Arabia in March 1949, giving rise to swarms Similarly, in April of the same year, gregarious breeding was noted in Baluchistan Gregarious breeding was observed also in some parts of north-west Africa

A sudden rise in locust population in India was observed towards the end of May, the population rising to about 800 locusts per sq mile in some localities Some locusts of the gregarious phase were met with, and these had obviously come from western countries This infiltration continued during June and July, and the maximum population of 19,200 locusts per sq mile was observed on 13th July at Kaki (Bikaner)

The monsoon broke out in the second half of June Rainfall was heavy and extensive in some parts of Rajasthan, Jodhpur having recorded 739 cents, Barmer, 1313, Phalodi, 1363, Jaisalmer, 477, Bikaner, 1113 and Sikar, 1220 During June, the rainfall was mostly concentrated in Jodhpur (Phalodi area) and Bikaner districts (Kaku-Bhadla area) In August-September, the western districts also received heavy rainfall.

After the first shower of rain, locusts became sexually mature and started laying eggs by the end of June Hoppers were fairly grown up in the last week of July in Kaku-Bhadla-Hansasar area of Bikaner and Ajasar-Rohena area of Phalodi Control operations were organized against a huge population The survivors which escaped destruction in these areas moved about and got scattered, raising the population in the neighbourhood A maximum of about 9,000 per sq mile was reached during August at a few localities Late migrants (end of July) also laid eggs, and the second brood was located in Amla area (Phalodi) and Loia-Hadda-Bholasar area of Kolayatji (Bikaner) during September-October By the end of September, a yellow swarm entered Jaisalmer from the north-west (Pakistan) and apparently laid eggs in the western parts of Jaisalmer and moved into Khairpur Mirs Large bands of hoppers were discovered in north-west Jaisalmer extending from Kishengarh to Shahgarh over a gross area of about 400 sq miles near the Indo-Pakistan border Some breeding was also observed at one locality in eastern Jaisalmer in the middle of October There was breeding during October in west Bikaner also (Bikaner and Anupgarh tehsils) covering an area of about 250 sq miles near Bahawalpur State Control operations were soon organized and the situation brought under control, only a couple of small swarmlets could develop in Jaisalmer and Bikaner areas The operations were concluded in the first week of December

Simultaneously, breeding occurred during October in the desert area of Bahawalpur and Khairpur Mirs States and Thar district of Sind, where the locust breeds at the same time as in Rajasthan. This was detected by Pakistan's Locust Organization early in September (in the Chachhro area) after which control operations were organized As it was widespread and had extended into the remote corners of the desert area, such as south-east Bhawalpur and east Khairpur Mirs, many concentrations appear to have escaped destruction and hoppers fledged into adults The tendency of hoppers, which bred along the Indo-Pakistan border, was to migrate towards east and south and thus big concentrations were found coming into Kishengarh, Tanot and Shahgarh tehsils of Jaisalmer district during October-November, requiring large-scale operations and, therefore, involving the aid from Defence Forces of the Government of India.

Locust Situation in 1950

India was free from swarms during the winter However, one swarm came into Jaisalmer from Pakistan towards the end of January but it went back after a couple of days. In Pakistan several swarms were present throughout the winter and spring Some swarms were observed in southern Iran also Breeding took place on a fairly extensive scale in D I Khan district of N W F P and several districts of Western Punjab, viz Mianwali, Khushab, Muzaffargarh, etc Hoppers were noted from the beginning of March onwards During April-June, breeding took place on a fairly extensive scale in northern Baluchistan also Control measures were undertaken by the Pakistan Organization, but apparently several hopper bands escaped destruction, particularly in western Punjab It is reported by the Director of Plant Protection, Pakistan, that during spring breeding was in progress in parts of Afghanistan bordering on N W F P and that many swarms developed in that area The breeding areas are shown in Fig 1

In the second week of May, a number of swarms entered India from the Pakistan side The invasion was in full swing up to about the middle of July and some locusts came in later also The swarms visited almost all districts of East Punjab, PEPSU, Rajasthan, Saurashtra, U P, Madhya Bharat, etc, the easternmost limit being Patna and Ranchi in Bihar In the southern direction, they reached some northern districts of Madhya Bharat With the onset of the monsoon, the swarms which had gone into Bihar returned to U P (Fig 1) Similarly, there was a check to their further movement in the southern direction The swarms got concentrated in Rajasthan and from the second week of July the activity of swarms started declining This was mainly due to the fact that in the wake of good rainfall swarms were settling down to breed Egg laying was reported from several parts of Rajasthan since the middle of July and hoppers started hatching out at several localities from the 23rd or 24th of that month It is feared that extremely heavy breeding will take place during this season in Rajasthan Unless the pest is destroyed in hopper stage, India will be overrun by swarms which would develop during September

Anti-locust Campaign

Anti-locust Organizations — The success of a locust campaign depends on two factors, viz (i) anti-locust organization, and (ii) efficacy of methods of locust destruction. The former is administrative and the latter technical Both are equally important Technical work includes, besides measures for destruction, locust intelligence, such as

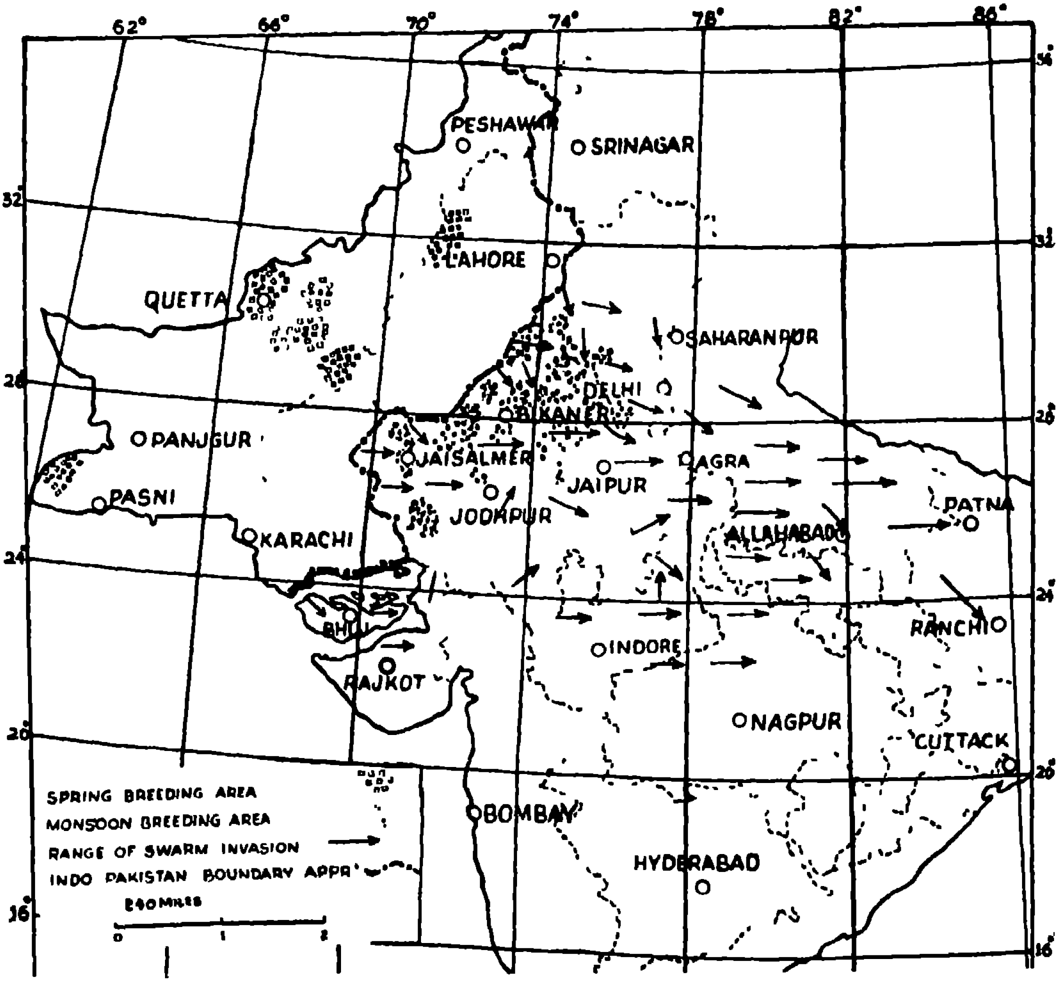

FIG 1 — LOCUST SITUATION IN 1950

collection of information regarding the time of swarm migration, their sites of resting, breeding and development On the basis of such information control equipment is moved and labour arranged to carry out control operations in time

Since locusts breed often far away from inhabited tracts, the work of collecting information on their occurrence, movements and actual breeding has to be carried out mostly by rural authorities and villagers under the guidance of trained technical staff Officers of the revenue, police, forests, excise, railways, etc, work in rural areas, and since for locust control operations timely recruitment and movement of labour and transport of equipment have to be ensured, the primary responsibility for such work falls on the Revenue Department and its village officers, viz *Patwaris* Other departments, however, are also important because the normal duties of the officers lie in rural areas and they can render valuable assistance in the collection of locust information and in educating villagers in anti-locust measures It is, therefore, essential that every State should enlist the assistance of all officers belonging to various departments as an integral part of its anti-locust organization and arouse the interest of all inhabitants

For purposes of technical work, the Indian States can be divided into two parts The permanent breeding grounds of the locust are the desert areas of Rajasthan and the neighbouring parts of Punjab (Hissar district), PEPSU, Saurashtra, Bombay, etc In such permanent desert breeding areas in which foreign swarms generally breed initially, multiply and thence spread to other States, the responsibility for technical work is that of the Central Government The Government of India are maintaining a permanent Locust Warning Organization, the staff of which is posted at strategic points in the main permanent breeding areas, with a substation at Jodhpur This Organization works under the control of the Director, Locust Control, and Plant Protection Adviser to the Government of India, Ministry of Agriculture, keeps close watch on fluctuations in locust populations in the permanent breeding grounds even when the locust is not active and studies the changes in locust phase from solitary to gregarious and vice versa In order that control measures may be organized by all States as soon as there are signs of increase in locust activity, the Director, Locust Control, at New Delhi, issues weekly or fortnightly reports which describe locust situation and contain timely warnings He also keeps a close watch on the locust situation in other countries in the belt which, as already explained, extends up to west Africa This is essential in order that India as a whole may be in a position to anticipate the approximate time of outbreak of a locust cycle in any area in the belt When a cycle breaks out, similar studies on a more intensive scale have to be undertaken in order to determine the time and direction of swarm invasions from foreign countries Within India also the Central Locust Warning Organization has to intensify its surveys This organization is considerably expanded to cope with the increase in intelligence work Villagers and rural officers also assist in this work

As regards the actual destruction of the pest in desert breeding areas, a Control Wing is added to the Central Organization for conducting and supervising control operations which are carried out in close co-operation with the officers of Revenue and other departments of the States concerned

In the States in which permanent desert breeding areas do not exist, such as the U P, Madhya Bharat, etc, anti-locust work starts when a locust cycle actually breaks out. The technical authorities in these States are kept informed by the Director, Locust Control, Government of India, of the changes in locust population in permanent breeding areas in India and abroad even when the locust is in the solitary phase During a cycle, the anti-locust work in a State has to be carried out by the rural departments and the technical department of the State concerned on the same lines as in the permanent breeding areas Similar arrangements have to be made in the cultivated areas of Rajasthan and other States which contain permanent desert breeding areas Since the locust situation is inter-dependent in various States of India, in the same way as the locust situation in the country as a whole is dependent on the situation in other countries in the locust belt, the anti-locust work in India has to be co-ordinated by a single all-India authority The Director, Locust Control and Plant Protection Adviser to the Government of India, Ministry of Agriculture, is entrusted with this work

The Government of India have expanded considerably their Anti-locust Organization during 1950 The budget for locust work during 1950-51 is about 10 lakhs of rupees as against 1¼ lakhs of rupees budgeted during 1949-50 before the outbreak of the cycle This figure, however, includes cost of 18 new light trucks, 6 land rovers fitted with power-operated dusting machines, about 700 hand-dusting machines, etc About 30 outposts have been established in Rajasthan and in adjoining States Additional staff has been appointed and the Locust Warning Organization has the same strength now as during the previous cycle of 1940-46 It will be recalled that during the previous cycle a part of the expenditure incurred (cost of labour, pesticides, etc) in desert breeding areas was distributed among the beneficiary states This time, however, Government of India have agreed to finance the entire scheme for at least one year Such expenditure during the current year is estimated to be about Rs 4 lakhs

All non-desert States, particularly those adjoining Rajasthan, Punjab, Madhya Bharat, U P., PEPSU, etc, have also established Anti-locust Organizations and have equipped them with pesticides and appliances Locust breeding in these States is not likely to be extensive or menacing because the majority of swarms have got concentrated in desert areas as described above.

Nodular Cast Iron—Literature Report No. 10

B S SRIKANTIAH & B R. NIJHAWAN
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IT is well known that graphite in cast iron has a very marked effect on its properties In the basic metal structure of grey cast iron graphitic carbon is distributed in the form of flakes the size and shape of which vary according to composition, cooling rate, method of melting, etc It is this flaky graphite structure which breaks the continuity of the matrix and is responsible for the poor mechanical strength of grey cast iron When cast iron is under stress, intense local stresses develop at the edges of the flakes which may exceed the elastic limit, resulting in local distortion or strain This effect has marked influence on the physical properties of the iron The low tensile strength as well as the high fatigue ratio and good damping capacity are also attributed to it In malleable cast iron these drawbacks have been overcome by annealing white cast iron The metal, after it is cast, is annealed so that roughly spheroidal aggregates or nodules of graphitic carbon are formed

Thus, the mechanical properties of grey cast iron could be considerably improved if the graphite in the metal could be had in the nodular form instead of being flaky Recent investigations at the laboratories of the *British Cast Iron Research Association* have led to the development of a new process for producing cast iron containing nodular graphite in the as-cast state No annealing treatment is necessary to obtain this structure The nodular graphitic structure in the iron is achieved by the addition of suitable quantities of cerium to the molten metal of suitable composition More recently certain American investigators[1,2] have been able to obtain this structure by the addition of magnesium Morrogh[3-6] claims that under appropriate conditions both processes will produce grey iron castings with all the graphite in the nodular form, giving the finished casting superior mechanical properties

The new product resembles malleable iron in having a nodular graphitic structure, but has not the same properties as malleable iron which can be subjected to considerable deformation and distortion prior to fracture According to Pearce[3 7], this nodular iron is a new product between ordinary grey iron and malleable iron and may be regarded as a high-duty cast iron with special qualities rather than as a new form of malleable iron. The material, however, possesses the properties of the present high-duty cast irons in use and is readily castable and machinable

Nodular Iron by Cerium Additions

Irons having under-cooled graphitic structure are found to be suitable for this purpose, since they solidify and graphitize immediately after solidification

Morrogh and Williams[4,8] have studied the nickel-carbon and cobalt-carbon systems and showed that it should be possible to obtain nodular structures in cast irons by the addition of a carbide-stabilizing element to retard carbide decomposition The element added should be a desulphurizer also Low sulphur content very likely assists in achieving the desired structure

It was found by Morrogh and Williams[4] that addition of cerium to cast iron of appropriate composition would produce spherulitic nodular graphitic structure

Cerium metal could be added as such to the molten metal It can also be added in the forms in which it is commercially available Misch metal, containing between 43 and 50 per cent cerium together with other rare earths and a little iron and manganese, has also been employed Misch metal dissolves readily in cast iron at all temperatures above 1,200°C Its solution in cast iron is not violent or explosive. Misch metal is produced from monazite sands The composition of a standard alloy of this type is cerium, 50-55 per cent, lanthanum, 22-25 per cent, neodymium, 15-17 per cent, iron 0 5-3 per cent, and the rest 8-10 per cent consisting of other rare elements.

The cast iron employed should have the following characteristics and composition (1) the iron must solidify grey even without cerium addition, (2) the carbon content should exceed the value $4{\cdot}3-1/3(\%Si+\%P)$, (3) silicon preferably about 2 3-7 per cent, (4) sulphur content should be as low as possible and after treatment should be below about 0 015 per cent, (5) phosphorus content should not exceed 0 6 per cent and preferably below 0·1 per cent, and (6) manganese, copper and nickel, chromium and molybdenum may be present in small amounts singly or in combination, provided condition (1) is observed

Cerium, when added to molten cast iron, first combines with the sulphur present and acts as a desulphurizing agent As long as the sulphur content of the metal is above about 0 015 per cent, this desulphurizing action will take place When the sulphur content is reduced to about 0 015 per cent, metallic cerium goes into solution in the molten cast iron The cerium content at this stage should exceed 0 02 per cent of the metal to induce the formation of nodular graphitic structure

The structure and cooling curve data of cerium-treated nodular irons, in which special care was taken to ensure that sufficient cerium remained in the cooling ingot, have been examined by Morrogh and Williams[6] They observed that on slow cooling to room temperature the samples showed well-developed hypereutectic spherulites with quasi-flake graphite The sample was found to be completely graphitized when it is quenched from 1,087°C and has the same graphitic structure as the slowly cooled specimen The samples quenched just after complete solidification (i e about 1,140°-45°C) were found to be substantially white with some small and some large graphite spherulites.

Nodular Graphite by Magnesium Addition

Donoho[1] has described the results of the investigations conducted at the *American Cast Iron Pipe Co.* on the use of magnesium Suitable precautionary measures have to be taken while carrying out the addition of magnesium since magnesium in any form may be violently explosive Nodular cast iron can be produced by adding pure stick magnesium on to the surface of iron in the ladle, but 95 per cent of magnesium may be lost In spite of this, with an addition of 1 per cent of magnesium, sufficient metal may be retained to produce the nodular graphite structure. One practical method of adding magnesium in the ladle is to use an alloy in which the magnesium is diluted to make the mixture non-explosive It has been observed that the 80 per cent copper and 20 per cent magnesium alloy is not explosive but burns quietly on the surface of the metal This alloy appears to be suitable for use in a commercial foundry More efficient methods of adding magnesium have still to be developed The results can be summarized as follows (1) high-strength cast irons with the graphite in the nodular form are produced by incorporating 0 03-0 10 per cent of magnesium, (2) pure magnesium and several magnesium alloys are effective in producing nodular graphite irons, (3) magnesium recovery and convenience of addition were found to be better with copper or nickel alloys of low magnesium content, (4) advantages of magnesium treatment over cerium treatment are that magnesium is effective in low carbon, high phosphorus and relatively high sulphur irons, (5) ladle addition of a graphitizing inoculant (such as ferro-silicon) after the magnesium addition is useful for controlling the structure and machinability of nodular irons. A granular graphite inoculant, however, causes reversion to flake graphite, (6) there is an optimum magnesium content for a given iron, too little magnesium results in a mixed structure and too much of magnesium causes increased hardness and brittleness, (7) excessive holding time after magnesium treatment may result in loss of magnesium and reversion to flake graphite, and (8) tests on keel block test bars of magnesium-treated cast irons gave strength-ductility properties superior to most malleable irons and approaching those of cast steels

Properties

Table I gives the mechanical properties of nodular cast iron (obtained by treating with cerium) with those of untreated iron

TABLE I

MATERIAL	TENSILE STRENGTH RANGE (tons/sq in.)	SHOCK RESISTANCE (ft. lb.)	BRINELL HARDNESS NUMBER
Untreated cast iron	24 28	25-60	250-400
Nodular cast iron	17-60	25-120	180-500

The endurance or fatigue strength is markedly improved in nodular cast iron This superior endurance may be explained by the fact that there is a reduction in the severe internal notch effect arising from the flaky graphite structure This improvement is an important result of the change in structure The heat and growth-resistance properties also show marked superiority in nodular cast iron Flake graphite makes the grey iron easily oxidizable and it is found that grey irons are susceptible to destructive growth at high temperatures The machinability of nodular cast iron is generally superior to that of grey iron The material can also be readily welded following the techniques established for grey irons Casting quality of nodular cast iron is excellent Fluidity is about the same as grey iron of like composition It is, however, observed that spherulitic iron has a distinct tendency towards piping

Applications

Nodular cast iron constitutes a new high-duty cast iron with great flexibility in its mechanical properties The product bridges the gap between cast iron and cast steel In the cast condition it is a superior cast iron of high strength, high elastic modulus and good ductility It can be heat treated to improve its properties further and bringing it close to cast steel An important feature is its low cost

The material is likely to have numerous applications in the automobile and agriculture implement industries and in the manufacture of castings for use in railways Crankshafts, pumps, compressors, valves and heavy industrial equipment, such as rolls, rolling mill housings, are other instances where the high strength and rigidity of the new material may be useful It may also find application in the manufacture of pipes, textile and electrical machinery, marine equipment, etc

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Inventory of Research Equipment & Materials

THE UNESCO SCIENCE CO-OPERATION OFfice for South Asia at Delhi is undertaking to compile an inventory of research equipment and materials available in universities and other research laboratories in the region The information so collected will help scientists in formulating plans of research and to facilitate co-operation among workers interested in any particular branch of research The inventory would give an idea of the present condition and the future needs of scientific materials in this region and help to promote closer co-ordination in research and development on an international scale

The survey will cover only specialized apparatus and will include information on apparatus, manufacturer, date of procurement, price or estimated cost and its present condition and serviceability Rare chemicals isolated from natural sources or synthesized artificially including enzymes, hormones and other biologicals not available commercially and pure cultures of micro-organisms collected and maintained in the region will constitute another list It is proposed to include mainly those types of cultures which are intended for special studies or for industrial research.

Additional points of information on which data should be collected are invited by the UNESCO Science Co-operation Office for South Asia, University Buildings, Delhi

The Distribution of Anthocyanins*

R. WILLSTATTER (1913-1916), the most important of the pioneers in the field of anthocyanins, isolated many of these colouring matters in a pure condition and proved that they are glucosides of the colour nuclei, the anthocyanidins The botanist Molisch (1905) was actually the first to show that the anthocyanins could be crystallized outside the plant In 1907 a synthetic method was discovered in Perkin's Laboratory in Manchester, of quite general applicability to the whole group of benzopyrylium salts, of which the anthocyanins were later shown to be members In spite of many difficulties, eventually Robinsons and his co-workers were able to synthesize all the anthocyanidins and the more important anthocyanins

The anthocyanins are isolated in the form of oxonium salts, usually the chloride, and on hydrolysis with hot 10-15 per cent hydrochloric acid they break down into anthocyanidin chloride and glucose or other sugars. The three chief anthocyanidins are pelargonidin, cyanidin and delphinidin In addition a methyl ether of cyanidin (peonidin) and three methylated delphinidins, malvidin, petunidin and hirsutidin, are known

In monoglucosidic anthocyanins the sugar is always attached to the hydroxyl in position-3 The monoglucosides of pelargonidin, cyanidin and malvidin are callistephin, chrysanthemin and oenin respectively The 3-galactoside of cyanidin is idaein The diglucosidic anthocyanins may be 3-biosides, e g mecocyanin is cyanidin 3-gentio-bioside and antirrhinin is cyanidin 3-rhamnoglucoside. In an important group, glucose units are attached to different hydroxyls The 3 5-diglucosides of pelargonidin, cyanidin, delphinidin and malvidin are pelargonin, cyanin, delphin and malvin respectively

The properties of the individual anthocyanins are highly characteristic and distinctive and the possession of pure synthetic samples afforded an essential basis of comparison This applies not only to the recognition of known anthocyanins in plant material but also to the study of any anthocyanin exhibiting unusual behaviour. The most generally useful properties are, however, the "distribution numbers" between immiscible solvents and various colour reactions, especially because the study of these does not always necessitate the isolation of the pigments in a pure condition The ferric reaction, a deep-blue colouration produced in neutral or slightly acid solutions, either aqueous, alcoholic or amyl alcoholic, indicates free hydroxyls in positions -3′ and -4′ and is, therefore, positive for cyanidin, petunidin and delphinidin only Petunidin and delphinidin alone are at once destroyed by aerial oxidation in alkaline solution This serves to distinguish petunidin from cyanidin The behaviour of anthocyanidins and anthocyanins in solutions of varied *p*H depends on the number and position of the hydroxyl groups and is largely independent of the nature of other substituents The presence, however, of co-pigments has a large effect

The most striking result obtained on the chemical side is the prevalence of the anthocyanins based on the three main types, pelargonidin, cyanidin and delphinidin There are just a few exceptions Gesnerin, the anthocyanin of *Gesnera fulgens* (orange flowers), is one such The anthocyanidin was soon recognized as one that had already been synthesized (5 7 4′-trihydroxy flavylium chloride) and then the anthocyanin itself (5-glucoside) was synthesized This is the first case noted of the occurrence of an anthocyanin with no substituent in position-3 To this category belongs carajurin, the main constituent of the rare cosmetic pigment "Carajura" It is the colour base of carajuridin chloride (5 4′-dimethoxy-6 7-dihydroxy flavylium chloride) This may originate from an anthocyanin similar to gesnerin.

A very important group is that of the nitrogenous anthocyanins easily distinguished from the usual types by their quite different behaviour The best-known example is betanin in the common beet but the group is fairly well represented Little is known about the chemistry of these colouring matters but the composition of two of them suggests that they may be ordinary anthocyanins in which amino acid residues are attached to the benzene rings by means of the amino group Synthetic compounds of this type have been made and show similar properties

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* Summary of the Dr Bimala Churn Law Lecture delivered by Prof Sir Robert Robinson, in January 1950, at the Indian Association for the Cultivation of Science, Calcutta.

The nitrogenous anthocyanins are found in five related orders only Similarly, there are certain families which produce only one of the three main types, although there are many others in which only two occur and still others in which pelargonidin, cyanidin (or peonidin) and delphinidin (or its methyl ethers) all occur The occurrence of pelargonidin and delphinidin in the more differentiated plants suggests that the pigments themselves require more steps for their synthesis.

The usual anthocyanins are found in young fern fronds together with some of unusual constitution not yet identified. Anthocyanins are normal constituents of green leaves Permanently pigmented leaves contain pelargonidin, cyanidin or delphinidin derivatives and autumnal reddening in the vast majority of cases is due to cyanidin glucosides

It appears that many plants have at hand a ready mechanism for the production of anthocyanin and it is incredible that this should have no deep physiological significance We do not yet know what this function is Different parts of the same plant yield different anthocyanins A variety of Nasturtium (*Tropaeolum majus*, Empress of India) was found to contain pelargonidin 3-bioside in the petals, cyanidin 3-bioside in the sepals and a delphinidin diglucoside in the leaves, indicating that the three types are derived by modification of a common precursor. The conviction that this precursor is changed most naturally into cyanidin glucosides is based on the almost universal appearance of these under conditions of stress (injury, drought, etc) but it is also derivable from a statistical survey of the colours of flowers

The influence of climatic conditions is very marked , there is a high proportion of delphinidin derivatives among Alpine flowers and a preponderance of pelargonidin derivatives in those growing in tropical and subtropical countries.

Finally, there is the very interesting class of leuco-anthocyanins which yield anthocyanidin on treatment with alcoholic hydrochloric acid in presence of oxygen , the distribution of these colourless substances is very wide They are nearly always to be found in woods, nutshells as well as in softer structures Most leuco-anthocyanins are convertible into cyanidin, but some give pelargonidin and some delphinidin

All related types, catechins, flavones, flavonols, leuco-anthocyanins and anthocyanins are regarded as different manifestations or modifications of a proto-type, a $C_6\,C_3\,C_6$ structure It is assumed that this type is derived from two molecules of hexose and one of triose The linking by aldol condensations requires one of the terminal nuclei to be less oxidized than the other and, in fact, cyanidin is the natural result by dehydration without oxidation or reduction

The genetics of flower colour is a subject demanding full and separate treatment Dr Scott-Moncrieff has suggested as the result of complete genetic study of dahlia that the anthocyanins are produced from two substances, one of which is always present in sufficient amount and the other in limited amount The relation of this to $C_6\,C_3\,C_6$ hypothesis is evident, because the substance present in limited amount is presumably the $C_6\,C_3$ intermediate One clear outcome of this work is a definite indication of a relationship between anthocyanin production and flavone production If the limited component is used to make much flavone, it is not available for anthocyanin and vice versa There are also intermediate positions and this is very important

The geneticist can do chemical experiments *in vivo* , by introducing a new gene, for example, a methylation factor, he can observe its operation on a new anthocyanin. It is probably from researches in this field that we shall get the fullest knowledge of chemical processes affecting anthocyanins

Finally, attention should be drawn to the existence of complementary genes, the presence of both of which is necessary for the development of anthocyanin Two further complementary genes are necessary for the production of anthoxanthins The chemical basis of these and similar phenomena is quite unknown

Indian Salt Industry

THE Report of the Salt Experts' Committee constituted by the Government of India in April 1948 to advise the Government on the measures necessary to put the salt industry on a sound footing has been recently published In an exhaustive survey, covering all aspects of the industry, the Committee have suggested measures to increase the production, improve the quality and reduce the cost of salt manufactured and make the country self-sufficient within a reasonably short time

The production of salt in India has increased from 12,12,000 tons in 1930 to 23,31,000 tons in 1948 The production figures for the two years at different centres and the target figures for 1955-56 are given in Table I

TABLE I

	1930-31 (tons)	1948 (tons)	TARGET FOR 1955 56 (tons)
Inland Works			
(i) Sambhar	2,73,000	3,16,000	9,46,000
(ii) Didwana	20,000	47 000	
(iii) Pachbadra	45,000	70 000	
(iv) Kharaghoda	1,00 000	1,36,000	
(v) Dhrangadhra		58,000	
Marine Works			
(i) West Bengal		1,000	30,000
(ii) Bombay	3,82,000	4,50 000	4,65,000
(iii) Kathiawad	25,000	2,93,000	5 15,000
(iv) Kutch		65,000	
(v) Madras	3,63,000	8 10,000	9,20,000
(vi) Orissa		20 000	60,000
(vii) Travancore		61,000	75,000
Rock Salt Mines			
Mandi	4,000	4,000	65,000
TOTAL	12,12,000	23,31,000	30,75,000

The present production (23,31,000 tons) falls short of the estimated consumption by 2,98,000 tons and this is being met by imports The country's requirements in the next 5 years is expected to go up to 3 million tons

The bulk of the salt produced in India is from sea brine and salt is raised by solar evaporation in numerous places distributed along the sea-board stretching from Bombay to Calcutta Rock salt deposits occur in Mandi State and inland salt lakes are found at Sambhar, Didwana and Pachbadra in Rajasthan The methods of salt production have remained more or less unchanged for decades and the quality of salt raised from a large number of the salt-producing areas is sub-standard The production sites have not been selected with proper regard to economic advantages and factors such as initial density and continuity of supply of brine, rainfall distribution, temperature, relative humidity, wind velocity, surface of exposure, impermeability of soil and protection of sites against floods and dust storms The Committee have examined these factors in detail and have made valuable recommendations appropriate to each area for improving the production and quality of salt The measures recommended include (1) maintenance of a high ratio between crystallizers and condensers , (2) removal of bitterns regularly and draining off the crust before lifting , (3) leaving behind a layer of salt on the crystallizing beds to form a clean floor , (4) setting up of control laboratories , and (5) the consolidating of small uneconomic holdings into units with a minimum area of 100 acres each

Several improvements have been suggested to enable the existing works at Sambhar Lake area to work more satisfactorily As a first measure the Committee have recommended a detailed survey of the lake bed A modified design of a percolation canal has been prepared to replace the present system of canals, and to reduce the present crystallizing area at the works and convert it into condenser area The present practice of throwing away of bitterns from crystallizers is harmful and is likely to affect quality of brine and of the salt produced, and should be discontinued It is preferable to harvest two grades of salt, one between 26°-29° Be and another between 29°-32° Be instead of a single crop Large-scale production of salt in pans under the direct control of Government and the use of improved methods of lifting brine from the wells and the installation of mechanical washing plants and the establishment of a research station to study the problem of byproduct recovery and the production of salt of standard quality are other measures recommended.

The methods now followed for producing salt at Didwana are unsatisfactory and the salt produced is unfit for human consumption Advantage is not taken of the wide seasonal fluctuations in temperatures prevailing here to bring about a separation of sodium sulphate and salt A careful and planned investigation of salt production in this area, and also in other inland areas now operating under private management, is recommended The latter include Kuda works in Dhrangadhra and areas in Rajasthan, Kutch and E Punjab

Recovery of Byproducts

The recovery of byproducts from the inland and marine resources has not received adequate attention With the exception of the salt worked out at Mithapur, Kharaghoda, Dhrangadhra and Travancore, no attempt has been made to recover the valuable byproducts such as magnesium chloride and sulphate, bromine, iodine and sodium and calcium sulphates Table II gives an idea of the quantities of byproducts that could have been recovered from 23 3 lakh tons of salt produced in 1948

As a potential source of sodium sulphate, the Didwana Lake remains largely unexplored. The lake bears a resemblance to the Dale Lake (California) where temperature fluctuations are taken advantage of to separate the salts This method can be adapted with advantage in this area and as much brine as possible lifted during the cold season and subjected to pre-cooling to separate out sodium sulphate

Sodium sulphate as an industrial raw material is of special interest to India Its utilization for the production of vital chemicals, caustic soda and sulphuric acid deserve consideration The Committee recommends the exploitation of these sources under Government control

Gypsum is now being recovered at Adirapatnam by *Messrs Mettur Chemicals*, at Jamnagar, Kandla and, more recently, at Mithapur The Committee are, however, of the opinion that the processes employed for the recovery of byproducts at many of the centres are not efficient and improvements are essential to obtain a satisfactory recovery

Distribution of Salt

The distribution of salt in the country, at present, is effected through a zonal system under which the principal regions of production and consumption are grouped under 8 foci of distribution (Fig 1) The Committee consider that the present railway freight for salt is excessive and should be revised and be put on the same footing as foodgrains to reduce wholesale and retail prices

Model Factories & Research Units

In order to organize the Indian salt industry on modern lines and make it operate economically and efficiently, the Committee consider it essential for the Government to set up model factories as demonstration units in the principal salt-producing tracts. These factories should have an area of 100 acres and should produce common salt required for human consumption as well as for industry, mixed salts of potassium and magnesium and other byproducts such as gypsum and sodium sulphate The estimated capital outlay for each model factory will be about Rs 2 lakhs and should be borne by the Government Seven such factories, two in Bombay, three in Madras and one each in Travancore and Orissa, are to be set up The model factories located at Bombay, Madras and Travancore should have research units attached to these for investigating into methods of improving the quality and yield of salt and of recovering byproducts A separate research station is to be set up at Sambhar Lake to tackle technical problems pertaining to inland salt resources

TABLE II

	COMMON SALT	BYPRODUCTS						
		$CaSO_4$	$MgSO_4$	Na_2SO_4	KCl	$MgCl_2$	Na_2CO_3	Bromine
Marine salt works	17,00,439	95,593	1,48,076		76,849	3,39 804		5,755
Kharaghoda and Dhrangadhra	1,93,606	6,757	9,024		7,812	87,399		1,180
Sambhar	3,16,495			44,799	668		20,043	229
Didwana	47,391			18,076			8,588	
Pachbadra	69,985	2,938	11,018			2,253		
TOTAL	23,27,916	1,05,288	1,68,118	62,875	85,329	4,29,456	28,631	7,164

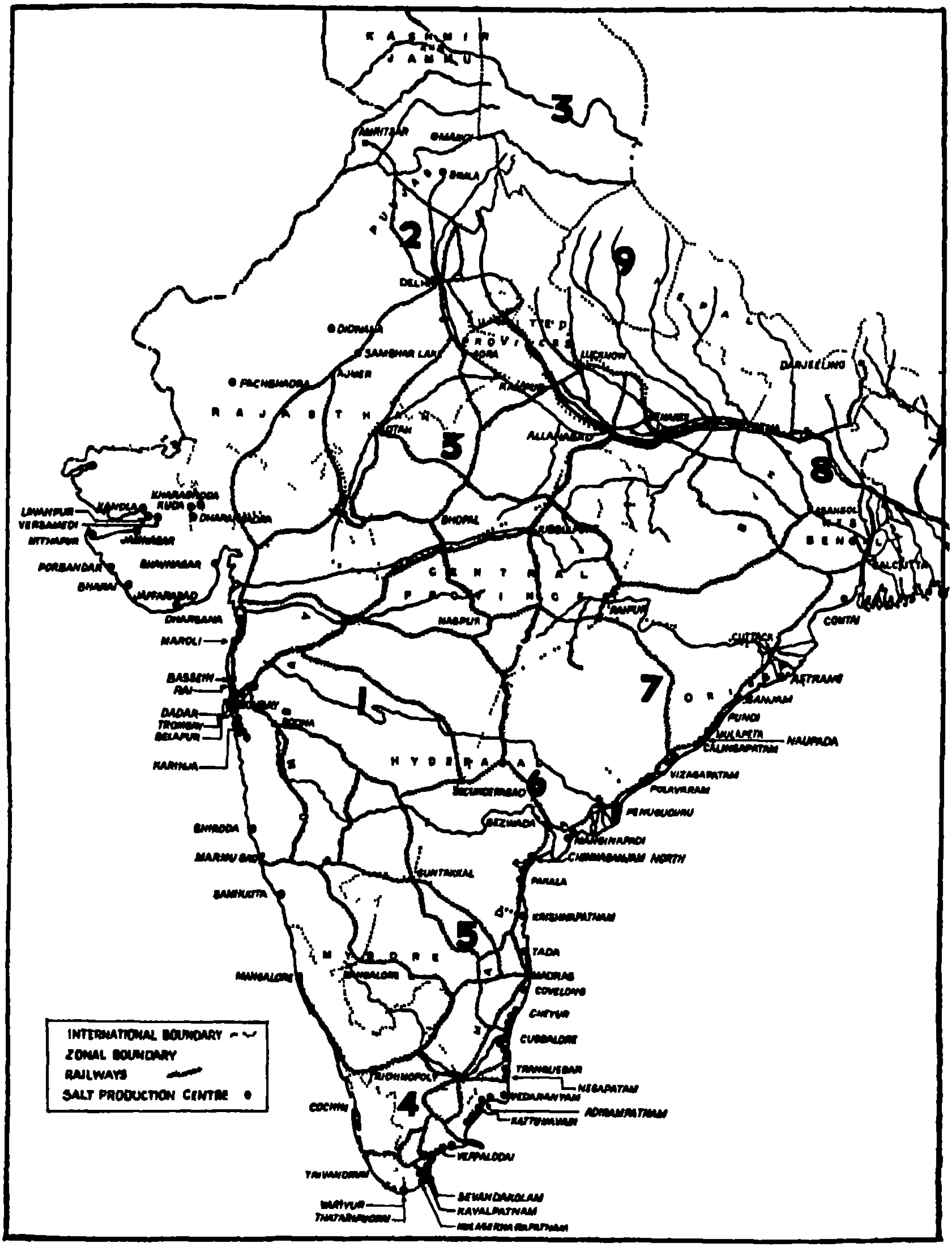

FIG 1 — MAP OF INDIA SHOWING SALT PRODUCTION CENTRES AND THE ZONES OF DISTRIBUTION DURING 1949 DISTRIBUTION ZONES 1 BOMBAY, 2 SAMBHAR (R S S DIVISION), 3 KHARAGHODA, 4 TUTECORIN, 5 ADIRAPATNAM, MADRAS AND CUDDALORE, 6 PENUGUDURU, 7 NAUPADA, 8 CALCUTTA, 9 DHRANGADHRA

Quality of Salt

According to the Committee the Draft Specification issued by the Indian Standards Institution prescribing a minimum sodium chloride of 96 per cent for edible salt is on the low side and should be raised to at least 97 5 per cent and maximum limits to be prescribed for other impurities

The methods of drawing samples from bulk consignments and of assaying the samples should be standardized and made available in the form of a code of practice

Salt Advisory Committee

To implement the steps recommended for the development of the industry the setting up of a permanent Salt Advisory Committee consisting of representatives of Government manufacturers consumers and importers is recommended The Committee is to advise Government on all questions dealing with production distribution import and export and any other matter that may arise from time to time

The Committee is in favour of small manufacturing concerns and associations in different parts of the country federating into bigger regional units and ultimately forming an All India Federation of Salt Manufacturers

The levy of a salt cess at the uniform rate of one anna per md of salt on the entire salt produced in the country is suggested It is recommended that the heavy chemical industries should be allowed a rebate equal to the cess collected on the salt consumed

In order to carry out the programme outlined it is considered that the present organization and set up of the Salt Department should be reorganized and adequately staffed to provide technical assistance both to Government and to industry

The Committee is not in favour of opening new salt works in the Madras area until the factories improve the quality of salt produced and make it acceptable to the Calcutta market and till a demand for export develops The existing works would increase their production by more than 12 lakh tons by improving the methods of manufacture and by properly realigning their factories The setting up of a large factory at Contai under the management of the Central and West Bengal Governments is recommended with a view to encourage the development of salt industry in West Bengal

The potential capacity of the existing salt works in the country is estimated at 40 26 000 tons per annum The Committee conclude that subject to the implementation of its recommendations it is within the reach of the industry to meet not only the present requirements but also attain the target figure by 1955 56

REVIEWS

Analytical Chemistry and Chemical Analysis, 1948, Proceedings of the International Congress on Analytical Chemistry, Utrecht, Vol II (Elsevier Publishing Co Inc , New York, Amsterdam, London, Brussels , London distributors Cleaver-Hume Press Ltd), 1948, pp x + 437 Price 25s

THE PUBLICATION IS A REPRINT OF THE issue of *Analytica Chimica Acta*, 1948, **2**, pp 417-854, and the pagination remains unaltered The book is valuable as a full account of the proceedings of the Congress in Utrecht in 1948 which established a new status for analytical chemistry The Congress covered very wide grounds, divided into five sections and consisted of formal lectures, presentation of original papers and plenary sessions All the lectures and papers are printed in full followed by a summary in English, French and German, along with the discussions that took place

In Section 1, entitled " General Methods and Standardization ", papers on statistical aspects of chemical analysis, the place and task of analytical chemist in industry, rationalization, standardization and codification of analytical methods and recent developments in gas analysis, organic elementary analysis, isotopes as tracers and analysis with mass spectrograph are included

Section 2, entitled " Electrical Methods ", surveys methods and recent developments in polarography and amperometry and is covered by eminent authorities like Heyrovseky and Kolthoff Other papers of interest are those on controlled potential electrical analysis, electrical methods in the analysis of water generally in industry and a continuous reading vacuum-tube voltmeter In all the methods the problem of precision and sensibility was considered

Section 3 is " Emission Spectrography " The papers in this section are to be published in *Spectrochimica Acta*

Section 4 on " Optical Measurements and Physical Methods of Separation" contains odd combination of titles but contains a masterly review on the recent developments in chromatography and is followed by papers on the analysis of hydrocarbon mixtures by absorptive percolation and analysis of hydrocarbon oils by thermal diffusion Optical measurements are covered by a survey of colorimetric and photometric absorption analysis, indicating the accuracy obtainable with different types of instruments two reviews on the analytical application of infra-red spectrophotometry in general and in powders and a method of determination of vitamin D_2 Research papers on the measurement of width instead of intensity of Raman lines for quantitative work and on the influence of reagent concentration on colorimetric determination of copper are presented

Three papers, one on determination of traces of oxygen in water in this section and two in the next section on determination of trace elements in biological material by spectrographic or photocolorimetric procedures are presented

Section 5 deals with microbiological methods A review on microbiological methods of analysis deals with all aspects, stresses the necessity of statistical evaluation of errors of assays and calls for cautious interpretation of results Two papers on details in the use of lactic acid bacteria for microbiological assay in general and assay of tryptophane follow Other two papers deal with the use of *Aspergillus niger* for the estimation of trace elements like potassium, copper, magnesium and molybdenum by weighing the mycelia or by a photronic measure of colour of spores It is rather surprising that at an International Congress session there were no papers on biochemical methods This is a very important branch of analytical chemistry and we hope in future sessions this defect will be rectified

Most of the papers have been followed by lively discussions The main functions of such international congresses are comparison of various methods with a view to determining sensitivity, reproducibility, ease and quickness, standardization of procedure and codification and discussion of new methods developed Judging from such standards the Congress has been a success

To the reviewer the most significant of the papers are the opening address and the theses on standardization and codification and rationalizing of analytical methods

A significant point arising out of the discussions of these papers is the definite need for continued research on the accuracy and sensitivity of analytical methods in general our knowledge of the lower limit of applicability of a method and the effect of variations in procedure being very unsatisfactory

Trends in most countries fortunately are for standardization of routine analytical procedures including chemical glassware apparatus etc though many still remain of a national character Also analytical methods when published should be printed in a standard format to facilitate comparison and standardization and as a safeguard against lack of details important for the execution of the method This plea for codification is particularly significant since this has not yet attained even a national character International congresses such as the one reviewed should bring in a study of such national standardization into an international standard and it is gratifying to note that these papers have stimulated considerable discussion in the Utrecht Congress

President C J van Nieuwenburg has sketched the progress of analytical chemistry to a status equal to any other branch of research and emphasizes the point that because of the demand for greater speed and accuracy and the need for handling small and micro quantities of material the classical gravimetric and volumetric methods are being replaced and supplemented by physico chemical and physical techniques But we rather agree with Dr Wenger who has critically summarized the proceedings of the Congress in feeling that there has been undue emphasis on automatization and physical methods Many physical methods have to remain as aids to classical fundamental chemical analysis Besides the classical methods present the advantage of being useful without the necessity of costly apparatus not in the reach of ordinary worker or small laboratories

Of very great significance to scientists in India is the fact that modern analytical chemistry is becoming a specialized science with its interest in optical electrical and microbiological methods besides the classical methods and makes high demands in the training of its users It becomes imperative that intensive efforts should be undertaken for the training of analytical chemists as a class and conduct research in chemical analysis than is hitherto being done in this country if we are to keep abreast of other countries Analytical chemistry should be made a subject of special study in universities and research institutions

The Netherlands Chemical Society which organized the Congress and the publishers of the proceedings the *Elsevier Publishing Co* deserve our sincere thanks This book should find a place as an indispensable reference work in all scientific laboratories

V S GOVINDARAJAN

Aircraft Structures by David J Peery (McGraw Hill Book Co Inc New York) 1950 pp xxii + 329 Price $ 3 00

THE WEALTH OF THE MATERIAL COVERED IN David J Peery s book *Aircraft Structures* is not readily seen at a glance from the chapter headings The author has done a remarkably thorough job in presenting the basic material for the analysis of semi monocoque as well as truss type of structure in a concise manner In his work he has attempted to present a simple basic treatment of aircraft structures with preliminary emphasis on fundamental structural theory This of course does not in any way alter the position regarding the analysis of aircraft structure though new material and new construction methods are developed

The reviewer agrees with the author that most of the theory outlined in the text book is applicable to any design requirement and for any material The author has covered a variety of topics in eighteen chapters and a large number of worked out examples are given at the end of each chapter thus bringing home to the student the types of problems that are confronted with in actual practice while stressing an aeroplane

There are certain noteworthy features about this volume They are the analysis of monocoque structures with cut outs bending trusses induced due to torsion shear lag analysis and explanation of the buckling of cylindrical shell by means of non-linear theory The determination of the spanwise air-load distribution, a topic which is usually not covered in text-books on aircraft structures, is also included in this volume The reviewer feels that it is a bit advanced for undergraduate students

Whatever may be the justification of the author in regard to the sequence of the material presented in the book, the reviewer feels that the topics are not arranged in order, for chapters on preliminary design data should have been dealt with at first An aeronautical engineer should first know the aeroplane layout and applied and design loads before he actually proceeds to analyse the structure In this respect there seems to be a serious slip on the part of the author

Most of the methods outlined in the book are up to date and are employed in factories by practising engineers, particularly the shear analysis of multi cells and the analysis of incomplete tension field beams Chapters sixteen, seventeen and eighteen need special mention In chapter sixteen, the author has dealt in detail with the methods for the determination of deflection in either truss type of structure or semi-monocoque structure by means of the method of virtual work and Castigliano's theorem In chapter seventeen, statically indeterminate structures are treated, such topics as the stress analysis of fuselage rings, multi-cell wing structures, etc, are covered In chapter eighteen, a group of special methods are presented, such as the moment of area method and conjugate beam method for the determination of the deflection of beams, truss deflection by elastic loads, beam column and moment distribution method for both continuous beams and continuous beam columns

The author feels that this volume serves as a text-book for undergraduate course But in the opinion of the reviewer, it is a bit unwieldy for a student to cover all the topics in one year and certain portions are too advanced for study in undergraduate course However, the author is to be congratulated for introducing some of the complicated topics into undergraduate level, and this book should prove a welcome addition to the teacher, the student and the practising engineer

V CADAMBE

Electronics in Engineering, by W Ryland Hill, McGraw-Hill Electrical & Electronic Engineering Series (McGraw-Hill Book Co Inc, New York), 1949, First Edition, pp 274 Price $3 50

ELECTRONICS IS BEING APPLIED WITH EVER-increasing tempo in many branches of science Electronic instruments are being employed with advantage for control, detection and measurement in the fields of physics and engineering Electronic instrumentation is an essential necessity for research in many branches of physics, especially in nuclear physics and radioactivity Research workers and students of physics and advanced engineering therefore find a positive need for an understanding of the fundamental principles of electronics and its applications so as to enable them to apply this knowledge for problems of control and measurement in their respective fields

Electronics has a vast literature, meant only for the advanced student and the specialist The publications on electronics for the use of laymen and amateurs are prolific Neither of these give a thorough and comprehensive view of the fundamental principles of electronics and its application for research workers and students who have to employ electronic instruments in their research The book under review entitled *Electronics in Engineering*, is designed as a text for this class of students in physics and advanced engineering The work deals with the theory and analysis of fundamental electronics and explains practical applications to illustrate the uses of electronics in various fields of physics and engineering The book, therefore, will be found useful to these students

This work is divided into sixteen short chapters to enable the student to select the subject that interests him in his specific problems Of the sixteen chapters, the first discusses the atomic structure and methods by which the electrons are emitted out of metals The second chapter explains the thermionic law and describes the different types of emitters and diodes and their respective efficiency In this chapter there is also a brief account of contact rectifier and the copper oxide and the selenium rectifiers The third chapter gives a brief account of single phase rectifier circuits The fourth chapter gives the theory and explains the operative principles of a triode, tetrode, a pentode and a beam power tube with their respective characteristics

The fifth chapter, after giving an account of various forms of electrical discharge in rarified gases and vapours, describes gas-filled tubes, their operation, characteristics and efficiency An account of the theory, design, construction and operation of different types of photo-sensitive devices is given in the sixth chapter The seventh chapter describes briefly various forms of electronic control circuits which are very frequently used in industry and pure research The eighth chapter deals with different types of circuits used in poly-phase rectifiers

An elementary treatment of wide band and tuned amplifiers with a discussion of R C coupled, direct coupled and transform coupled units, both of the power amplifying and the push pull type their operation and frequency response is given in the ninth chapter The tenth chapter gives the theory of feedback with a quantitative feedback expression and describes negative and positive feedback and their applications in R C coupled amplifiers and cathode followers The eleventh chapter gives a short account of resonance and tuned amplifiers the functions of the resonant circuit in a tuned amplifier and tuned power amplifier The twelfth chapter deals with an elementary theory, design, construction of different types of oscillators and their application in high frequency heating In this chapter a brief account of frequency control and wide range oscillators are discussed

The thirteenth chapter explains the theory of amplitude of modulation and demodulation and the general operation of superheterodyne receivers The fourteenth chapter deals with a cathode-ray oscilloscope, its design, construction, operation and application for observing repeating wave forms, plotting curves comparing two frequencies for measurement and calibration, recording single-sweep transients, timing by Z-axis modulation, and recording continuously a large number of cycles of a non-repeating wave In chapter fifteenth an account is given of different types of transducers for translating signals from one form to another It gives the principle and the method of operation of persistence strain gauge and the differential transformers used for very small mechanical measurements The last chapter of this book describes the theory and principle of operation of vacuum-tube voltmeter used for both a c and d c voltage measurements

The author should be congratulated for bringing out this valuable work I have no doubt that the work would be found useful by research workers and students The book should be a valuable addition to scientific and technical libraries

SWAMI JNANANANDA

Recent Advances in Radio Receivers, by L A Moxon Modern Radio Technique Series, Edited by J A Ratcliffe (Cambridge University Press) 1949, pp ix + 183 Price 18s net

THE BOOK MAINLY DEALS WITH THE PROBLEM of inherent noise in a receiver, its origin and measurement and discusses the advances made in the methods for improving the signal-to-noise ratio It is this inherent noise in a receiver which ultimately puts a limit on the smallness of signal which can be usefully received Any improvement in this respect increases the efficiency and performance of a receiver

The contributions of the various stages of a receiver to the noise factor are fully discussed and methods of improving it are explained The discussion of the circuit design has no doubt special reference to short wave receivers such as radar and television receivers but the new ideas introduced can be usefully adopted for an improved noise factor in other broadcast receivers

What an average reader will most appreciate is the exclusion of all intricate mathematics from the discussion without impairing in the least the physical exposition of the subject Formulae do appear, and sometimes their derivations too, but only when they are necessary to give precision to design considerations

The book, however, will be found most useful by those who have kept themselves abreast with the developments in radio technique till the outbreak of World War II and who now wish to know the advances that have been made in the technique during the war years Coming as it does from an author who has himself made considerable contributions to these advances the book is of interest

A S BHATNAGAR

The Economic Prospects of Chemical Industries in India by A K Madan Technological Director Messrs Industrial Chemicals (India) Bombay (Thacker & Co Ltd Bombay) 1950 pp 402 Price Rs 20

THIS IS A BOOK WITH A PURPOSE ITS PUBLICATION is opportune It opens with a general survey of the industrial and other problems facing the country it is followed by a chapter on mineral and other resources three chapters dealing with reviews of various chemical industries and six on chemicals required in a number of industries In the concluding part brief accounts are given on the materials of construction in the chemical industry labour welfare in chemical industries and industrial training Four indices are included

The author has endeavoured to provide adequate information on the availability of raw materials for different industries as was reviewed the development of various chemical industries in the country with particular reference to their potentialities The book will prove particularly useful to those engaged in trade and business and it provides detailed information on the types of chemicals manufactured in India chemicals which are imported and chemicals required in twenty two industries Data on production and trade given in Appendix B are specially useful

The first part of chapter III dealing with resources is well written The later portion however lacks precision and fails to bring out the bearing of the subject discussed on chemical industries The information given in chapter V Fertilizers Including Ammonium Salts is not always to the point An important omission in the publication is the absence of a bibliography of references We hope the author would remedy this defect in the next edition The printing and get up of the book are good

The book represents a laudable effort and can be recommended not only to the average business man as a reference volume on Indian chemical industries but also to the student of chemistry who is interested in a general survey of the chemical industry in India

SEN GUPTA

Frequency Modulated Radar by David G C Luck (McGraw Hill Book Co Inc New York) 1949 pp xviii +466 Price $4 00

FREQUENCY MODULATED RADAR AS DISTINGUISHED from pulse radar is comparatively a new technique and any book dealing with the principles and possibilities of f m radar is always welcome

The principle of the f m radar is well known With this the range is measured from the change in the frequency during the time interval between the instant of transmission and the receipt of the signal reflected from the target But if the target is moving there will be a shift due to Doppler effect and this will give the speed of the moving object also The various aspects of this problem have been dealt in the book with the help of simple mathematics

The book describes first the general principles of range determination including some aspects of motion of aircrafts and missiles Some types of f m radar system developed and used in World War II have been described e g radar altimeter AN/APN 1 low altitude automatic bombing equipment AN/APG 4 and AN/APG 6 (XN)

The author has taken pains to explain most of the problems from first principles and the materials have been presented in a manner which will be very helpful even to readers entirely unfamiliar with the specialized subject of f m radar

S P V

NOTES & NEWS

Scientific Research in Industry

IN A LEADING ARTICLE APPEARING in a recent issue of *Nature* (1950 **166, 41**) the place of scientific research in industry has been discussed The article refers to a debate held in the British Parliament on the question of the fullest possible development and utilization of resources with a view to ensuring effective progress in industry and various other fields the later part of the article is devoted to a critical appreciation of the problems discussed during the debate in the light of a recent publication *Co operative Industrial Research* * by Prof R S Edwards

Many aspects of the question were discussed during the debate including technical and higher technological education the balance distribution and remuneration of scientific and technical man power and the general structure of research organization in Britain How far the results of research are being effectively used in industry and whether the work of the research associations and that of the Department of Scientific Research was fully made use of by industry whether the research associations are fitted for the creative and inventive work on which the industrial progress finally depended and whether there is sufficient collaboration and co ordination of the research units under various Departments of State were some of the important issues discussed

The debate brought forth a number of facts and suggestions It was felt that for the small or even medium sized firms to set up independent laboratories might be a waste of scientific man power To bring scientific information to the smaller progressive firms it was suggested that institutions such as Chambers of Commerce should give training fellowships in industry on condition that they employ a scientific man of the highest standard who would be encouraged to maintain his academic contacts as well as gain the widest knowledge of the industry and its problems

The organization of co operative research and fundamental aspects to appraise fully the place of research associations in the industrial economy of United Kingdom and their future are the issues discussed in the book by Prof R S Edwards Prof Edwards has attempted to ascertain by means of a fairly wide canvas of industrial opinion what industry thinks of research associations The book provides a useful insight into industrial opinion on the possibilities and limitations of co operative research Compulsory levy for financing research associations is advocated as a measure for the future development of co operative research Overlapping of research association s programme is regarded of slight importance a note of caution is sounded against attempts to eliminate overlapping of research programmes by excessively large organizations and ponderous schemes for co ordination

The value of research associations pursuing fundamental research in solving problems economically in the long run and also as a measure of sustaining the quality of the staff and the scientific standing of the association was stressed

It is pointed out that research into the constitution and behaviour of materials on which research associations are at present concentrating is particularly suited to co operative research effort Work on the scientific and technical aspects of specification and on the devising of standards is considered a valuable function of research associations Market Research in general is an inappropriate study for research associations It is felt that research associations should co operate in those operational research studies which are most closely associated with the scientific and technical aspects of industries in which they are interested and full weight should be given to the information advisory and testing services of the associations in any scheme of expansion

The location of a research association or institution is considered an important factor in its success or failure It is indicated that *proximity to the industry served may be far more vital than proximity to another research association with which facilities or services may be shared*

One argument put forward against the conduct of sponsored research by research associations rests on the embarrassment arising out of secrecy of a particular project

The effective use of man power and of material resources must depend on the right choice of subjects This is pointed out as one of the essential questions to which an answer must be found if an opinion is to be formed on the value of research associations

The most important factor in the future development of research associations will be the quality of the staff they succeed in attracting and the associations must be able to create conditions and opportunities which will attract competent men While it is made clear that given capable direction and competent staff the co operative research association is a valuable form of industrial institution it is pointed out that it does not follow that the research association movement should be developed at the neglect of other forms of research organization

Electronic Telescope

THE ELECTRONIC TELESCOPE DESCRIBED in a recent issue of *Discovery* (1950 **11, 172**) is reported to be either actually in operation in France or in a very advanced state of development

The idea of the electronic telescope represents an interesting conjunction of a number of lines of research The use of infra red radiation to form an invisible image on a screen electrons from which are accelerated *in vacuo* to form a similar but more intense image in visible light on a second fluorescent screen is the basic principle underlying the design of the instrument It has many features similar to the electron microscope and embodies modern vacuum and high tension techniques

The conventional photographic plate in a telescope is replaced by a vacuum tube carrying on its inner face a thin layer of caesium The luminous parts of the image cause the ejection of electrons from this caesium layer into the vacuum tube In effect a luminous picture of a part of the sky is formed which emits no light but electrons The electrons can be rendered more energetic by putting two electrodes into the tube and applying an electrostatic potential of about 50 000 V between them This device is similar to the one developed for an electron microscope and all the electrons emitted from a point of the original picture are received on a photographic plate and produce a blackening of the plate

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* *Co operative Industrial Research* by Prof R S Edwards (Sir Isaac Pitman & Sons Ltd London)

One of the greatest advantages claimed as far as light intensity goes is that a 20" telescope can be made to perform as well as a 200" telescope

The operation of such an instrument poses some intricate problems for instance the vacuum system will require very powerful pumps and in addition the presence of very high voltages will make the working conditions far from simple

Electronic Polarometer

AN ELECTRONIC POLAROMETER designed for greater accuracy and higher speed than was obtainable with existing commercial palorographs was described at the Physical Methods Group meeting of the British Society of Public Analysts held recently (*Chem Age* 1950 **62**, 780)

The instrument measures the maximum polarographic current rather than the usual average current The measurement which is made without affecting the emf applied to the cell involves adjustment of a potentiometer until an electronic null point indicator is balanced the current is then read off from the potentiometer to an accuracy of 1 in 1 000 For rapid operation the principle of tangent slope compensation is used which enables diffusion currents to be obtained directly without the need for the complete plotting of the polarographic wave or graphical construction Several further improvements on this instrument have been made in a commercial model built by *Mullard Electronic Research Laboratories* A very stable electronic battery circuit and a method of current measurement specially suited for a small polarographic wave preceded by a large one have been introduced For use in conjunction with the polarometer a dropping mercury electrode has been designed which incorporates a thermostat capable of taking ten cells at a time and is controlled to within 0 05°C

Manufacture of Solvents

METHODS OF SOLVENT MANUFACTURE based upon direct synthesis from lower saturated and unsaturated hydrocarbons developed commercially within the last 15 or 20 years are reviewed in the *Modern Methods of Organic Solvent Manufacture* by J L Edgar Royal Institute of Chemistry (Lectures and Monographs and Reports 1950 No 2)

Petroleum Solvents — A major development is in the methods of precise fractionation combined with azeotropic and extractive distillation The waste gases from petroleum cracking plants form the basis of a major synthetic chemical industry The gas stream can be separated into ethane ethylene propane propylene and butane butylene cuts by the hypersorption process in which the lighter gases are adsorbed selectively on activated charcoal and are then stripped from the absorbent this process is for example capable of giving recovery of 98 per cent ethylene with a purity of 92 per cent from a stream containing hydrogen methane ethane ethylene propane and propylene

A process has recently been brought into operation in England whereby not only aliphatic solvents but also a wide range of aromatic compounds are obtainable This is the Catarole process being operated by *Petrochemicals Ltd* The feedstock is a light petroleum fraction which is cracked in the vapour phase at 600° 700°C and at low pressure A copper catalyst is employed The yield of gaseous products varies from 45 to 63 per cent These are separated by fractional distillation into fuel gas methane ethylene a C_3 fraction and a C_4 fraction The hydrocarbons are later used for the manufacture of a range of solvents and derivatives The liquid product is first stabilized and then distilled in 3 stages for the separation of the aromatic constituents

The direct hydration method of ethylene was first operated on a commercial scale by the *Shell Chemical Corporation* America The method offers advantages because it eliminates the costly use of sulphuric acid A solid catalyst is employed and corrosion problems are therefore greatly reduced

A new plant to be installed by the *Shell Chemical Manufacturing Co* at Stanlow is to manufacture a wide range of solvents employing gas oil as the feedstock the cracking conditions being such that the quantity of cracked residue produced together with those gaseous fractions not required for chemical manufacture is sufficient to supply the fuel requirements of the entire chemical and auxiliary plants The cracking is carried out in the vapour phase at high temperature and low pressure and the products from the cracking furnaces are separated into two fractions a light fraction with an end point of 190°C and a heavy fraction which is used as fuel oil The light fraction is then separated by a process which is a combination of absorption and fractional distillation methods into fuel gas which contains all the hydrogen methane ethane and ethylene a high purity C_3 cut which contains about 92 per cent propylene a high purity C_4 cut a C_5 cut which is recycled to the cracking furnaces and a highly aromatic distillate which contains high percentages of benzene and toluene After suitable treatment the distillate will either be incorporated in motor fuel or it may be utilized as an aromatic solvent

Besides the above processes the manufacture of new solvents has been made possible in U S A by the manufacture of allyl chloride by the direct chlorination of propylene This process has now been used as the initial step in the manufacture of synthetic glycerol The process employs high purity propylene which is chlorinated without the aid of a catalyst at 500°C and at pressures only a little above atmospheric pressure resulting in the production of allyl chloride The reaction is highly exothermic and is allowed to take place in adiabatic reactors with very short residence times The allyl chloride is separated from the other reaction products from hydrogen chloride and from residual propylene by distillation and is obtained in a high state of purity Allyl chloride may then be hydrolysed to give allyl alcohol to give glycerol and other useful solvents and chemicals, e g epichlohydrin From di-allyl ether, which is produced as a byproduct in the manufacture of allyl alcohol, acrolein may be produced which, although itself not a solvent is a most important intermediate in the manufacture of numerous other synthetic chemicals and solvents

Levulinic Acid

THE PREPARATION OF LEVULINIC acid from sucrose and the use of sodium levulinate as an anti-freeze are described (*Research*, 1950, **3**, 140)

The essential steps in the formation of levulinic acid from aldoses and ketoses are aldose or ketose → 1 2 ene-diol → 5-hydroxy methyl furfural → levulinic acid + formic acid Levulinic acid is produced in much the same yield from glucose, fructose, sucrose or starch When 250 gm of sucrose was heated with 600 c c HCl of various concentrations, levulinic acid yields obtained are from 34 to 42 per cent of the theoretical Levulinic acid was obtained in high yields using hydrobromic acid as a catalyst and using 3 per cent concentration of sucrose with 8 per cent hydrobromic acid when the yield is 79 per cent Yields almost as high were obtained when sucrose was heated with hydrochloric acid containing 1 per cent sodium bromide The following procedure for the preparation and isolation of levulinic acid is used Starch is preheated with dilute HCl (1 5 to 2 5 per cent) at 100°C and the mixture is then heated in a pressure digester at 190°-200°C (with mechanical agitation) The temperature is raised at the rate of 1° to 4°C per min for 50 to 60 min The degradation of sugar maintains the desired temperature for a further half an hour The mixture is then filtered free from a granular humid material partly neutralized to pH 1 9 and evaporated to small bulk NaCl which separates is centrifuged off and the mother liquor is subjected to steam distillation under vacuum when a relatively pure form of levulinic acid of light colour together with a residual tar is obtained This tar has now been found to yield a further amount of levulinic acid by subjecting it to steam distillation

Cane juice has been found to be as efficient as pure sucrose in the preparation of levulinic acid The juice is evaporated to a syrup and heated in sealed tubes with acid reagents The acid formed in the reaction is isolated by the same solvent reaction process as that for pure sucrose

A two-stage process has been developed for the preparation of 5-hydroxy methyl furfural and levulinic acid from sucrose The sucrose is heated with oxalic acid, phosphoric acid, maleic acid even very dilute hydrochloric acid, in an autoclave at 150° to 160°C for 3 hr The reagents degrade only the fructose half of the sucrose molecule to 5-hydroxymethyl furfural After the weak acid treatment humid material is filtered off and hydroxymethyl furfural is removed from the solution by continuous extraction with ethyl-acetate The aqueous residue is evaporated to remove dissolved solvent, the appropriate amounts of hydrochloric acid and sodium bromide added and the mixture heated as before to convert the residual glucose into levulinic acid

The sodium salt of the acid has been found to be an efficient anti-freeze, within the limits set by an eutectic point in the region of 40 per cent w/v Being solid, it is more convenient to transport than glycol The behaviour of the aqueous solutions at temperatures up to boiling is satisfactory in respect to freedom from frothing and stability of pH and freezing point Laboratory corrosion tests, using metals or combinations of metals likely to be present in car systems, have given satisfactory results except for some thinning of solder at soldered joints Addition of 1 per cent w/v of sodium chromate or phosphate reduces the attack

Chromatographic-spectrophotometric Determination of Vitamin A

A METHOD FOR THE DETERMINA tion of vitamin A in petrol-ether extracts obtained from different materials employing both chromatographic and spectrophotometric techniques is described (*Acta Chemica Scand*, 1950, **4**, 618)

Before the new international regulations for the determination of vitamin A had been accepted in 1949 it was possible to determine the content of vitamin A in fish liver oil without purification of the solution obtained after saponification and ether extraction of the liver oil, prior to the measurement of the absorption spectrum The conversion factor 1600 compensated to some extent for the impurities present in the solution In the new international regulations prescribing the conversion factor 1900, it is required to separate vitamin A from the interfering impurities for its estimation

The vitamin extract is prepared by saponification and subsequent extraction with ether The ether extract is completely freed from all fatty acids by washing once with water twice with alcoholic KOH and finally twice with water The ether solution is evaporated to dryness and the residue dissolved in petroleum ether

To prepare the column for chromatography some scoured wool is placed at the transition from the broader to the narrower part of the adsorption tube The adsorbent (dicalcium phosphate) is introduced in small proportions suspended in petroleum ether Each time the powder is allowed to settle and then pressed together by suction The tube is filled with the adsorbent to 1 to 1½ cm from the top and then the column is ready for chromatography

A suitable quantity of the vitamin extract corresponding to 150 to 600 gm vitamin A is sucked through the column and washed with 25 to 50 c c pure petroleum ether (b p 70°C) The column is inspected in ultra-violet light where the vitamin A should be visible as a yellowish-green fluorescent zone in the column If such a zone is not visible, the solution contained too little or no vitamin A or the adsorber is too poor In the latter case a stronger adsorbent had to be applied When the vitamin is adsorbed satisfactorily to the dicalcium phosphate, the chromatogram is developed by continued washing with a petroleum ether-ethyl ether mixture (50 1) until the yellowish-green fluorescent vitamin A zone appears at the very bottom of the column A clean silicon flask is inserted and a mixture of petroleum ether-ethyl ether (50 1) is added until all vitamin A is eluated The fraction is transferred to a volumetric flask of suitable size which is filled up with petroleum ether so that the solution contains 2 to 4 μgm of vitamin A per c c This solution can be used directly for the determination of the adsorption curve in a Beckmann spectrophotometer

If the vitamin A from the solution available for chromatography cannot be absorbed on dicalcium phosphate, aluminium oxide should be used If aluminium oxide proves too strong, dicalcium phosphate, which has been heat treated more efficiently than normal, may be used

Values for the adsorption at 310 325 and 350 mμ with and without chromatographic separation of extracts from whale liver oils, cod liver oils, liver paste, butter, milk, vitaminized oats and fodder mixtures showed that the absorption curves after chromatography fall very closely to the adsorption curve of vitamin A a criterion in favour of the specificity of the chromatographic-spectrophotometric method

In experiments with pure vitamin A, losses during chromatography were found to be ½ to 2 per cent

Polarographic Determination of Titanium

A SIMPLE AND RAPID POLAROGRAPHIC method for the determination of titanium in paint pigments has been described (*Canad J Res*, 1950, **28**, 128)

An *E H Sargent & Co* Model XX polarograph was used with an ordinary electrolytic cell with an internal anode, maintaining a temperature of 25° ± 0 2°C All the wave heights were measured by the slope-intercept method The reagents used were concentrated sulphuric acid (sp gr 1 84), potassium bisulphate (A R), acid tartaric (A R), 25 per cent solution, titanium dioxide (A R) 7 gm of potassium bisulphate crystals were mixed thoroughly with 0 3 gm of the dry pigment and 20 c c of sulphuric acid added, the mixture covered, heated to fume off sulphur trioxide for 20 min and swirling occasionally It was cooled and transferred to a 100 c c volumetric flask, keeping sample and washings to less than 50 c c 50 c c of tartaric acid solution was added, made up to the mark and mixed A portion was transferred to a polarographic cell, deaerated and polarographed The overall time required for a single determination of titanium by this method is 1 hr When several samples are run at the same time, each additional sample requires about 8 min Besides filtration, the maintenance of Jone's reductors required in the usual method is avoided

To test the precision of the polarographic method, 5 samples from *Canadian Titanium Pigments Co* containing about 29 9 per cent TiO_2 were analysed polarographically The maximum deviation from the mean was 2 0 per cent and the average deviation 1 1 per cent The preparation of the samples contributed to the largest amount of error The values, on the whole are in very good agreement with those determined by conventional volumetric and gravimetric methods

Rapid Immersion Silvering

A NEW METHOD OF SILVERING developed at the Printing Packaging and Allied Trade and Research Association is described (*Chem Age* 1950 **63**, 14)

Most methods of silvering by the chemical reduction of an aqueous silver solution suffer from the defect that only a small portion of the reduced silver is deposited as a mirror The remainder is deposited either on the walls of the containing vessel or is precipitated in the solution Apart from the wastage of silver involved, this sludge is objectionable since it may spoil the mirror during its formation Increased efficiency in the methods employed (i e the proportion of precipitated silver deposited as a mirror) depends on the reduction of the rate of reaction by the addition of various inhibitors

Addition of 10 to 15 per cent pyridine to a 1 per cent ammoniacal solution of silver did not facilitate deposition of silver on the addition of hydrazine sulphate It was found that on a surface which has been previously treated with stannous chloride and washed with water a heavy silver mirror was rapidly deposited Despite the high rate of deposition maintained on the surface sensitized by the above treatment, very little silver precipitation occurred in the bulk of the solution or on the walls of the containing vessel and the solution remained perfectly clear and still usable 24 hr after preparation, during which time a number of silverings can be made

When the process was recommended as a practical means of heavily silvering plastics in the manufacture of special electrical components, it was found that the results obtained were markedly dependent on the source and quality of the pyridine used, and that no differential inhibition of silver reduction occurred when a sample of purity greater than 99 9 mol per cent, as established by the freezing point, was used Investigations carried out at the Chemical Research Laboratory, D S I R, London, showed that the satisfactory results were due to a small amount of a surface-active agent contained in pyridine When a sufficient amount of a surface-active agent was added to pure pyridine, differential inhibition of silver reduction was obtained It was also established that the variable behaviour of different pyridine samples was attributable to the varying proportion of surface active agent present The desired results could be reproduced by adding a suitable proportion of *Fixanol C* (cetyl pyridinium bromide) to inactive" pyridine, so that the process becomes completely controllable

Good differential inhibitions have been obtained by adding ammonia and cyclohexylamine instead of pyridine in suitable concentration together with cetyl pyridinium bromide, using solutions of the order of 0 001 per cent The following is a recipe The surface to be silvered is pretreated by being wetted with a solution of 10 gm $SnCl_2$ in 20 c c HCl (A R) and 80 c c water The surface is then rinsed with a 5 per cent silver nitrate solution, well washed with distilled water and kept under water until required Two silvering solutions are prepared Solution 1 consists of 10 c c of *Fixanol C* solution (0 005 per cent), 16 c c of 1 25 per cent hydrazine sulphate solution Solution 2 comprises 70 c c of 1 per cent solution of ammoniacal silver nitrate prepared by adding 0 8 per cent ammonia to 1 per cent silver nitrate solution until the precipitate just redissolves These two solutions are mixed just before use The amount of *Fixanol C* solution is adjusted to give satisfactory results No exact quantity can be recommended The process has proved useful as a tool to investigate the catalytic effect of silver, platinum and various other metals on the chemical reduction of metals from their aqueous solution The method should be of considerable use wherever the rapid and efficient deposition of a heavy silver film is required The process has already proved useful in the Telecommunications Research Laboratory to obtain a thick film of silver on to the inside of tubes This operation is employed with a degree of precision in applications where the spray method is not practicable It is considered that the process should prove useful for instrument manufacture and for laboratory requirements

Recovery of Spent Lubricating Oils

A METHOD FOR THE RECOVERY OF used lubricating oil by a process of chemical washing employing a simple washing tank having an arrangement for mechanical agitation and steam heating is as follows The tank is half filled with oil to be refined and while stirring a vegetable oil (coconut or groundnut) amounting to 2 per cent by volume of the lubricating oil is slowly added and the mixture heated to about 180°F by letting in steam Sufficient caustic soda lye (15°Be) is then added to saponify the vegetable oil and to leave a little in excess Stirring is continued for 6 hr at 180°F after which as much fresh water as can be conveniently handled is added and stirring continued for a further period of 4 hr maintaining the temperature at 180°F Steam is then turned off and stirring stopped The sludge is allowed to settle at the bottom and when the whole mass has cooled it is drained off from the bottom Sufficient amount of fresh water is again added steam let in to raise the temperature to 180°F and the process repeated as before Usually two washings are sufficient to free the oil from alkali The washed oil should be examined and filtered and tested for its specific gravity viscosity and other physical properties before use

The oil refined by this method has been found to be similar to original oil in its behaviour when used for lubricating purposes

C P CHACKO

Phosphate Fixation

RESEARCH WITH RADIO ISOTOPE phosphorus has shown that only about 10 per cent of applied phosphate is utilized by a crop and that iron and aluminium precipitate the soluble phosphate out and interfere with its assimilation Fixation is more rapid in acid soils at a *p*H of 6 0 considerable amounts of available phosphates are precipitated out by iron and aluminium

Recent research has shown that phosphate fixation is greatly reduced by some of the organic acids produced when organic matter decomposes in the soil Iron and aluminium form stable compounds with the organic acids and the phosphate remains free The most effective of the acids are citric oxalic tartaric malic and malonic — all those which are produced in largest amounts when bacteria decompose organic matter in the soil The effect of liming in reducing phosphate fixation is now considered a microbiological and not merely a chemical effect By reducing the soil s acidity bacterial action is stimulated and the production of the organic acids which repress fixation increased The threefold presence of organic matter fertilizers and the lime is therefore essential to active lasting soil fertility (*Farming* June 1950)

Aluminium Sterling Silver

STERLING SILVER ALLOYS CONTAINing aluminium have been investigated for their fire stain and working properties (*Bull Design & Res Centre* 1950 No 8)

When sterling silver containing about 1 per cent of aluminium is heated in air a thin film of aluminium oxide is formed on the surface This prevents oxygen penetrating the metal and oxidizing the copper and the fire stain is restricted to a very thin layer on the surface which is readily removed in the final buffing and polishing Alloys with an aluminium content ranging from 0 8 per cent to 2 per cent have been investigated Below 0 9 per cent the aluminium oxide film is not sufficient to prevent staining Over 1 5 per cent the working properties and colour of the silver are affected An alloy containing 92 5 per cent silver 6 5 per cent copper and 1 per cent aluminium required frequent annealings to achieve softness and ease of working When heated to high temperatures (over 690°C) this alloy did not show grains or the orange peel defect as in the case of the standard alloy The soldering of the aluminium sterling is more difficult especially with harder solders By scraping off the aluminium oxide from the surface however the alloy can be soldered with enamelling solders and subsequently enamelled in a furnace at 850°C

The silver aluminium alloy has a density 0 2 per cent less than that of the sterling silver

Mould Cleaning

A NEW TECHNIQUE OF CLEANING moulds in rubber industry is described (*Rubber Age & Synthetics* April 1950)

The moulds are immersed in hot fused salts at a specified temperature for about 30 min depending on the size of the mould After withdrawal of the moulds from the salt they are washed thoroughly in water and then carefully dried The application of a special brightening solution gives a lustrous finish The process is equally effective on light alloy type moulds also In the case of composite moulds washing and drying has to be more thorough to avoid risk of corrosion due to sweating at the intricacies between the dissimilar metals Washing in boiling water followed by a rinse in a solution of sodium bichromate (3 to 4 oz per gal at 200°F) is recommended The equipment required is a gas or electricity heated bath of a cubic capacity twice or thrice that of the largest mould to be treated The process is time saving efficient and easy to operate The salt used is quite inexpensive of low viscosity at the operating temperature highly soluble in water non poisonous and does not emit objectionable fumes The drag out loss of salt is very low and can be reduced to negligible proportions by allowing the moulds to drain after lifting from the bath

Details of the process are obtainable from the *Electric Resistance Furnace Co Ltd* Weybridge Surrey

New Staple Fibre

A COPOLYMER OF ACRYLONITRILE and vinyl chloride previously known as Vinyon N has now been produced as a staple yarn under the new name Dynel by *Carbide & Carbon Chemicals Corporation* New York

The fibre has the following characteristics high resilience warmth resistance to moth attack dimensional stability rapid drying resistance to acids alkalies and mildews and suitability for dyeing with acids or acetate dyestuffs The fibre is particularly adapted to the manufacture of blankets curtains, carpets, sweaters, shoe fabrics, snow and ski units, rain wear, tarpaulins insulation fabrics, dye and laundry nets, etc The moisture regain of Dynel is less than 0 5 per cent under standard conditions

Freeze-drying Apparatus

A NEW TYPE OF FREEZE DRYING apparatus using infra-red rays as a head surface for the liquid in the ordinary freeze-drying method has been developed in the U S A (*Chem Age* 1950 **62**, 780)

The infra-red wave band absorbed by water lies mainly between 20,000Å and 80 000Å units This energy, emitted by a series of electrically charged fine wires is absorbed directly by the water and evaporated The process needs a tenth of the time required by the older methods and the material need not be kept at so low a temperature A much lower vacuum suffices for obtaining satisfactory results

Census of Industries

THE SECOND STATUTORY CENSUS of manufacturing industries published by the Directorate of Industrial Statistics, Ministry of Industry and Supply, Government of India (Second Census of Manufactures in India, 1947, The Manager of Publications, Delhi 1950, Vols I and II, pp 762, price Rs 21/14) covers manufacturing establishments registered under Section 2(j) of the Indian Factories Act, 1934 29 industries out of the 63 groups recognized in the census are covered in the report (TABLE I)

The first census of manufacturing industries in India conducted under the Industrial Statistics Act of 1942 related to the year 1946 and was published in the year 1949 In the report of the second census the position during the year 1946 has also been shown in the various charts for purposes of comparison

Like the first report, the report of the second census also gives statistics relating to capital and labour employed, quantity and value of fuel and raw materials consumed, the quantity and value of products and byproducts and the value *added* by manufacture in each province for each industry Information relating to each industry is prefaced by a short summary and amplified with diagrams and charts The data given shows an all round progress in industrial development The number of factories existing in the area covered by the census was 5 643 in 1947 against 5 013 in 1946 the percentage distribution being Madras, 25 per cent West Bengal 23 per cent and Bombay, 16 per cent Rice milling had the largest number of factories followed by general engineering and vegetable oils forming 26 per cent, 21 per cent and 16 per cent respectively of the factories in existence The total productive capital in the 29 industries (TABLE I) was Rs 404 crores in 1947 against Rs 367 crores in 1946 Cotton textiles (Rs 132 crores), jute (Rs 52 crores), sugar (Rs 45 crores), iron and steel (Rs 33 crores), vegetable oils (Rs 31 crores) and general engineering (Rs 27 crores) account for 79 per cent of the productive capital in the 29 industries The 29 industries used 68 lakh tons of coal (valued at Rs 29 crores) in 1947 as against 60 lakhs (valued at Rs 23 crores) in 1946 The iron and steel industry consumed 31 lakh tons cotton textiles 14 lakh tons jute 6 lakh tons, cement 5 lakh tons and paper 3 lakh tons The quantity of purchased electric power consumed was 13 2 million kWh against 12 3 million kWh in 1946

The value added by manufacture (which is a measure of the increase in the total value of commodities added on by the manufacturing process and is calculated by subtracting the cost of materials supplies containers, fuel, purchased electric energy, contract work and the depreciation of fixed assets from the total value of products and work done by the industry for customers) was Rs 242 crores in 1947 against Rs 211 crores in 1946 Bombay contributed 36 per cent West Bengal 25 per cent U P 11 per cent, Madras 10 per cent, Bihar 10 per cent and other provinces and states 8 per cent The cotton textile industry contributed 42 per cent jute 15 per cent, sugar 11 per cent, iron and steel 7 per cent, general engineering 6 per cent and other industries 19 per cent

TABLE I

	INDUSTRY	REGISTERED FACTORIES IN EXISTENCE	PRODUCTIVE CAPITAL EMPLOYED Rs	VALUE ADDED BY MANUFACTURE (VALUE OF PRODUCTS LESS VALUE OF RAW MATERIALS AND FUELS LESS DEPRECIATION) Rs
1	Wheat flour	70	1,08 17,824	45 26,687
2	Rice milling	1,479	9,60 54 018	1,68 66 976
3	Biscuit making	99	1 21 04 764	91 00,276
4	Fruit and vegetable processing	24	23 21,787	7,12,480
5	Sugar	166	44 68 70 025	25,57,47,117
6	Distilleries and breweries	58	2,40 73 513	96 58 114
7	Starch	11	50 05 114	8 83,240
8	Vegetable oils	910	31 37 62,074	6 72 81,055
9	Paints and varnishes	30	2,71 58 166	1,71 43,484
10	Soap	43	5 21 01 151	2,54,95,128
11	Tanning	70	1,95 86 938	1 01,28,525
12	Cement	14	7 40 45 426	1,48,82 383
13	Glass and glassware	144	2,72,93,294	1,71,30,903
14	Ceramics	52	1 99 64 494	98,14,533
15	Plywood and tea chests	85	1,24,09,192	40 37,587
16	Paper and paper board	38	6,74,17,155	3,00,17,967
17	Matches	36	2,11 21,583	2,60,36,625
18	Cotton textiles	554	1,31 01 92,538	1 02,53,12,431
19	Woollen textiles	44	3 81 95 769	4 35,73,896
20	Jute textiles	99	51 78,31,935	36,41,30,071
21	Chemicals	191	15,73,55,706	8,00 48,582
22	Aluminium copper and brass	158	12 44,48,039	4,54,29,773
23	Iron and steel	104	33,11,90,755	17,99,94,394
24	Bicycles	11	70 45 578	31,65 283
25	Sewing machines	6	46 05,815	16,33,079
26	Producer gas plants	4	2,18,573	92,866
27	Electric lamps	7	51,65,996	14,84,569
28	Electric fans	43	1 82,86,944	87,99,620
29	General engineering and electrical engineering	1,206	27,23,07 626	15,06,01,201

Tables of Biological Tests

THE FIRST TWO NUMBERS OF VOL I of *Summary Tables of Biological Tests* have been published by the Chemical Biological Co-ordination Centre of the National Research Council of the United States Tables are arranged according to the type of test employed The first number contains anti-bacterial arachnidicide, fungicide, insecticide plant growth regulator, insect and rat repellency, rhodenticide, mammalian toxicity, anti-malarial brucellosis and cancer tests, and the same together with snail control and rickettsia are detailed in number two The test techniques are described and the chemicals tested are listed alphabetically (*Chemical Abstracts* system) with their structural formulae (*Nature*, 1950, **165**, 804)

The publication is available free from *National Research Council, Washington D C*

Announcements

Chemical Research Committee, C S I R —The various Committees and Sub committees in Chemistry namely the Heavy Chemicals and Chemical Industries Research Committee, the Electrochemical Research Committee and the Dyestuffs Sub-committee, under the Council of Scientific & Industrial Research, have been amalgamated into one comprehensive committee known as the Chemical Research Committee with effect from April 1950, for a period of 3 years, with the following personnel Prof J W McBain (Chairman), Dr J C Ghosh, Dr W D West, Prof P Ray, Dr B B Dey a representative of the *Indian Chemical Manufacturers' Association* Dr K Venkataraman, Dr Mata Prasad Dr S S Joshi and the Director, Scientific & Industrial Research (Members)

Statistical Laboratory, Allahabad — A statistical laboratory has been recently inaugurated in the University of Allahabad and the working of the laboratory is planned on the lines of the Brookings Institute of America The laboratory offers a 3-year course in statistics and aims at promoting quality control and increased production in industry through the application of statistical methods The Government of India have made an initial grant of Rs 50,000 towards its establishment

New Middle East Institute — The Columbia University of New York is establishing a Near and Middle East Institute to promote knowledge by research, teaching and dissemination of information in the following countries Greece, Turkey, Iran, Afghanistan Pakistan and other countries in this region For 10 years the expenses of the Institute will be shared equally by the Columbia University and the participating countries and thereafter the American University will assume full responsibility for future financing The Government of Pakistan has agreed to contribute $25,000 annually as its share in support of the Institute (*UNESCO*)

UNESCO Facilities for Scientists Abroad — With a view to assisting touring scientists to establish closer contacts with scientists in adjacent countries through which they pass on their journey and to enable them to discuss and exchange information on problems of mutual interest, it may be possible for UNESCO centres to make arrangements for their stay and to arrange their programme in those places The expenses for these arrangements are to be borne by the zonal Science Co-operation Office Scientists from south Asia region may contact the UNESCO Science Co-operation Office, University Buildings, Delhi, for details

Indian Pulp & Paper — The fifth anniversary number of this journal (July 1950, Price Rs 4) contains useful articles relating to various technical and economic aspects of the pulp and paper industry in India The developments in the industry in European countries are also reviewed Among other interesting articles published in the journal mention may be made of ' Review of the Indian Paper Industry ", "Research and Technical Training for the Indian Paper and Board Industries", ' The Nomogram in the Paper Mill", etc

The First General Assembly of the International Council for Building Documentation will be held in Paris from 23rd to 31st October 1950 The object of the Assembly is to promote international co-operation through the exchange of documentation facilities between the various national and international organizations concerned

Indian Pharmaceutical Congress, 1950 – The third session of the Indian Pharmaceutical Congress will be held at Calcutta on the 30th and 31st December 1950 under the Presidentship of Dr J C Ghosh, Director Eastern Higher Technical Institute, Calcutta

The First International Universities Conference will be held at Nice from 4th to 10th December 1950 The object of the Conference is to create an International Association of Universities 126 universities from 38 countries have agreed to participate

Errata

This Journal 1950, **9B**, No 9, September 1950, article entitled The Elastic Properties of Single Jute Filaments III — Nature of the Torsional Rigidity Modulus ", page 220, L H col, line 11, *for* " from the middle " *read* " from the crop, the middle", page 221, R H col line 43, *for* "investigation^{8}" *read* "investigation^{7}", page 222, Table III, column headings 5, 8 and 11 *for* "$\frac{W_1}{W_2}$" *read* "$\frac{W_2}{W_1}$", page 224, caption Fig 3, *add* " (arbitrary scale) " *after* ' Dynes sq cm ', and *insert* " Raw ●–●–●, Batched o - - o - - o "

Progress Reports

SUGARCANE RESEARCH IN INDIA

CHEMICAL AND BIOLOGICAL MEASURES FOR CHECKing the damage caused to surgarcane by pests and diseases the use of fertilizers to raise the yield of sugarcane and the suitability of different varieties of cane for different conditions of soil and climate are some of the main lines of research undertaken by the Indian Central Sugarcane Committee at its various research stations during the year ending 31st March 1949

To augment the production of sugarcane, specially the yield of cane per acre by intensive methods of cultivation, the Committee have launched 5-year development schemes in various states with the help of a special grant of Rs 75 lakhs from the Government of India Targets of production have been fixed for cane The important lines of work undertaken include better irrigation facilities distribution of manure and fertilizers on a subsidized basis, supply of improved and disease-resisting varieties of cane, arrangement of varietal and manurial demonstration plots on cultivators' fields, determination of appropriate cultural, agronomic and rotational practices The Committee have acquired a large farm at Lucknow to establish the new Institute of Sugar Technology and Sugarcane Research which is expected to be the largest institute of its kind in Asia A small sugar factory will also be erected at the site for providing research and teaching facilities

The Coimbatore Sugarcane Station of the Committee continued to supply suitable varieties of sugarcane for trial under the various soils and climatic conditions obtaining in different states Some Coimbatore canes have already been adopted for cultivation overseas, e g in South Africa Lousiana, Argentina, Brazil, Egypt, Portuguese East Africa, and Australia

Studies on (1) the photo-periodic factor in relation to flowering, (2) the effects of manurial and irrigation treatments on flowering, and (3) chemical composition of flowering and non-flowering varieties were continued during the year The different treatments of photo-period, irrigation and manure bridged up the disparity in flowering between early and late varieties The exploration of *Saccharum spontaneum* and allied species from South India (Madras, Travancore, Mysore and Coorg) has been completed and 152 types have been collected, among these 130 belong to *S spontaneum*, 10 to *E arundinaceus*, 10 to *Sorghum halepense* 4 to *Bambuseae* and 15 to grasses The *spontaneums* show good adaptability under divergent ecological conditions Certain types exhibit drought, frost and salt resistance, erect habit and profuse tillering and are expected to widen the scope of sugarcane breeding by enabling the introduction of these qualities in future commercial canes

Under the scheme for research on diseases of sugarcane in operation at the Indian Agricultural Research Institute, New Delhi, a large number of parent cane varieties were inoculated for testing their resistance to red rot The highly resistant varieties were *S spontaneum* (Glagah Java), *S spontaneum* (Coimbatore), Co 301, 393, 408, 411, 413, 440, 627 and 631

29 isolates of *Colletotrichum falcatum* collected from different cane varieties and localities were tested for their virulence on 10 selected cane varieties of varying genetic composition and susceptibility to red rot Field experiments have shown that (1) *Trichogramma* was able to effect a check on the stem borer *Argyria sticticraspis* by parasitizing a good percentage of the eggs, (2) the *Trichogramma* released plots always showed a higher parasitization than the non-treated ones, (3) the high parasitization of egg masses in the treated plots had brought about lower egg larval and pupal populations as well as lesser borer infestation and (4) plots with higher parasitization also gave increased yields of cane at the time of harvest Following these conclusions breeding laboratories for the mass production of *Trichogramma* have been set up at Walchandnagar and at Nellikuppam for releases of the parasite in larger areas of sugarcane A good laboratory host was found for the first time in the larvae of the grain moth *Corcyra caphalonica* for the mass multiplication of the larval parasite *Stenobracon* Experiments carried out at Shahjahanpur to test the effects of lead arsenate (5 per cent), corrosive sublimate (0 25 per cent), DDT (5 per cent), gammexane (80 lb per acre) and phenyl (1 50 in water) on the germination of setts and on the activity of termites showed that (1) setts treated with phenyl gave the highest germination, the chemical exercising a stimulating effect on the buds (2) DDT was most effective in preventing termite damage, while gammexane was ineffective when the soil alone was treated and (3) 20 to 30 lb of gammexane dust per acre applied in furrows prevented termite damage without impairing germination of buds Trials at Pusa yielded an increase of 72 mds per acre in the treated plots

Experiments on the availability of nutrients from different organic and inorganic manures, in the Shahjahanpur tract, have revealed that ammonium sulphate became available to the crop within a fortnight oil-cakes after about a month and bulky organics after about 2½ months of application With respect to sucrose content of the cane, the manurial treatments were in the following descending orders farm-yard manure, groundnut cake, town compost, press-mud ammonium sulphate and castor cake Sugarcane per acre however, was highest in the ammonium sulphate treatment followed by press-mud, groundnut cake, castor cake, town compost earth and farm-yard manure

Work on *gur* chemistry was started in the U P and a preliminary study of *gur* yields of cane varieties showed that best quality of *gur* was obtained from Co 313, 453 and 527 Amongst a number of clarificants tried, groundnut proved most efficient and *gur* so obtained absorbed less moisture and showed better keeping quality High phosphate, low chlorine, low organic non-sugar residues and nitrogen were characteristic of fines yielding good quality jaggeries Wilt disease investigations on sugarcane in Bihar showed that the *organisms* responsible for the disease was associated with red rot in Co 331 in the Bhagalpur district The disease however, existed independently in Co 313 331, 385 393, 453 508, B O 3 and 9 The isolates from wilted tissue consisted of *Cephalosporium sacchari* Butl and *Fusarium moniliforma* either singly or in association, but usually the former was obtained

Bionomical studies at Jullundur station showed a direct relationship between the number of cane at harvest and the height of cane as well as the yield Different varieties were classified on the basis of their relative resistance to different pests Co L 17 and Co L 22 were found resistant to pyrilla and Co I 21 and Co L 22 to top borers and Co L 17 and Co L 9 to the new pyralid borers

Technological research was mainly concerned with improvements in technique and equipment for the manufacture of *gur* and *Khandsari* sugar Improved processes evolved at Bihar (Moradabad) Research Station have made it possible to obtain a recovery of about 7 22 per cent of cane sugar as against 5 5 per cent usually secured by the indigenous processes and the quality of sugar compares favourably with that of the ordinary vacuum pan factory sugar

The effect of storage on the keeping quality of *Khandsari* sugar showed that the fall in purity was the largest in the case of sugars having a low *safety* factor, a relationship between the percentage of water and non sugars The Indian Institute of Sugar Technology is demonstrating an improved process and equipment for the manufacture of sugar by the open pan system at the important *Khandsari* producing centres

Experiments conducted at the Indian Institute of Sugar Technology, Kanpur, and the Indian Veterinary Institute, Izatnagar, have shown that molasses mixed with cane-bagasse can be utilized as a good feed for milch and draught cattle

INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE

THE ANNUAL REPORT OF THE INDIAN ASSOCIATION for the Cultivation of Science for the year 1949-50 records considerable progress in its developmental and other activities The construction of the new research laboratories at Jadavpur is nearing completion The new department of organic chemistry was inaugurated during the year and efforts are being made to have a department of theoretical physics also

The Association received a grant of Rs 4,00 000 from the Government of West Bengal and a loan of Rs 80,000 from the Government of India towards the construction of the new research laboratory buildings The Council of Scientific & Industrial Research also financed two research schemes (1) X-ray Investigation on Coal and (2) Construction of Osmometer for High Polymer Research

In the X-rays and Magnetism Department, the structure of phenanthrene crystal has been determined by the Fourier synthesis method The X-ray diffraction technique has also been employed for examining the process of glass formation and dispersion of salts in glass systems for identification of minerals in coal samples, for studying the efficiency of coal-washing investigation of carbonization process, determination of the changes in orientation of cellulose in infected tracheids and estimating the silica contents in dusts from mines

Investigations on the influence of high temperature on the paramagnetic susceptibilities of a number of Tutton salts showed in a number of cases a considerable change of orientation of the principal magnetic directions with temperature Thermo-e m f of metal semi-conductor junctions have been found to be much higher than those corresponding to metal-metal junctions working between the same temperatures and so the former type of junctions are found to be very useful for low temperature measurements

In the Department of Optics investigations on (1) the origin of low frequency Raman lines due to organic compounds in the solid state, (2) molecular structure of organic compounds in different states as revealed by their Raman spectra, (3) fluorescence and absorption spectra of diamond crystals of different qualities at different temperatures, and (4) *absorption of U H F radio waves by organic* liquids were carried out during the year The results of investigations on the Raman spectra have shown that intermolecular field has great influence on the Raman spectra in the liquid state owing to random orientation of the molecules and in the solid state this influence changes as the orientation becomes a regular one Investigations on the fluorescence of diamond have led to the conclusion that the fluorescence is due to impurity The frequency of the radio waves in the region of absorption peaks exhibited by some organic liquids shows that the frequency of hindered rotation of the polar molecules in these liquids is much smaller than that of the new lines observed in the Raman spectra of these compounds in the solid state and, therefore these lines are produced due to some other causes

Works on high polymers has been limited to fundamental studies on the process of formation of various plastics e g *polytyrene, polymethyl metha*crylate, nylon, etc Some new catalysts for polymerization, e g iron oleate aluminium stearate, etc, have been discovered and the mechanism of their activity has been investigated A simple method for determining the molecular weight of nylon has been developed

Investigations in physical chemistry have chiefly centred round detergents, surface active agents and soaps with reference to their formation and electrical properties

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for July and August 1950

Organic Chemicals

41208 Manufacture of salts of leuco compound and leuco sulphuric ester derivatives of vat dyestuffs *Treating the vat dyestuff with a metal in a neutral liquid in presence of organic quaternary ammonium halide* — I C I Ltd

42275 Process for the improvement of fastness properties of dyeings and printings produced from water soluble dyestuffs *The dyeings or printings are after-treated with an aqueous compound containing the grouping*—$N=C=N$— Ciba Ltd

Food & Kindred Products

42512 Extraction and separation of sugars and/or edible syrups from the molasses from a cane or beet-sugar factory *Dissolving molasses in an alcohol water solvent filtering after the solution and treating it with lime* — Dr C A Kloppenburg

Metal & Metal Products

42082 Method of casting metal ingots *Forming a shell of silicate material having a melting point below the metal-pouring temperature and then pouring molten metal at a temperature at least 1,200°C into the shell* — The Linde Air Products Co

Rubber & Rubber Products

42918 Improvements in driving means for crepe rubber rolling mills *Motor having an outgoing shaft running at a slow speed is directly geared to a roller to be rotated* — Aktiebolaget Svenska Kullagerfabriken

41572 Novel rubber products *Copolymerising styrene and like compounds with lesser amount of butadiene and the like in an aqueous rubber dispersion and subsequent treatments* — Dunlop Rubber Co Ltd

43354 Methods of compounding rubber *Forming a dispersion of the hardenable resin in the vulcanizable rubber* — Dunlop Rubber Co Ltd

Stone, Clay & Glass Products

43029 Manufacture of glass objects *The glass ribbon is deposited on the mould and as a result of the difference of pressure on either side of the mould engages the surface of the mould* — N V Philips Gloeilampenfabrieken

Plastics & Plasticisers

41338 A plastic material from shellac and resinols like bhilawan shell liquid or cashew shell liquid *Interacting shellac and resinols like bhilawan shell liquid or cashew shell liquid under steam pressure until a homogeneous product is obtained* — S Siddiqui, Sarin & Varma

41339 Moulding powders from shellac and resinols like bhilawan shell liquid or cashew shell liquid *Interacting shellac and resinols like bhilawan shell liquid or cashew shell liquid under steam pressure curing the reaction product and then incorporating fillers* — Siddiqui, Sarin & Varma

41340 Production of moulding powders from shellac and bhilawan resins *Filler particles with shellac deposited on them blended on hot rollers with bhilawan resin*—Siddiqui, Sarin & Varma

PATENTED INVENTIONS OF THE C S I R —*Continued from page* 388

In patent No 32237, the efficiency of expulsion is reduced by the need for conveying superheated steam to a separate vessel wherein the nuts are kept Further, a separate heating arrangement has to be provided for the vessel containing the nuts, and in this arrangement the nuts or shells nearer to the walls of the vessel are liable to get over-heated.

The present apparatus ensures speedier expulsion, avoids the need for a separate superheating arrangement and also eliminates local over heating of the walls of the vessel in which the nuts are treated

The apparatus consists of a steam jacket (2 in Fig 1), wherein steam is superheated and which is also provided with means for conveying the nuts or shell into the presence of superheated steam inside the jacket The apparatus is also provided with means for removing the expelled liquid

The oil-bearing shells are received in a perforated vessel or retort (1) placed inside the steam jacket (2) An even distribution of steam within the inner retort (1) is secured by varying the diameter of the perforations (4) of the inner retort with reference to their proximity to the steam inlet (11 and 12)

The steam jacket (2) and the inner retort (1) may be made of metal preferably copper and it is preferred to make them of semi circular (vide Fig 2) or semi-elliptical cross-section Only the flat top (3) of the inner retort is perforated One end of the inner retort is permanently closed The opposite end which receives the perforated tray (15) carrying the nuts is provided with a lid (6) which can be hermetically closed The outlet (8) of the inner retort (1) projects outside the outer steam jacket (2) The steam jacket as well as the inner retort have arrangements for taking a thermometer

Patented Inventions of the Council of Scientific & Industrial Research

EXPULSION OF LIQUID FROM THE NUTS OR SHELLS OF BHILAWAN OR CASHEW

Patent No 32237

S Siddiqui & A A Khan

The processes hitherto employed for expulsion of the shell liquids have been found to have an adverse effect on some of the valuable chemical constituents of the liquids such as bhilawanol in the case of bhilawan shell liquid or anacardic acid and cardol in the case of cashew shell liquid This fact constitutes a serious limitation for a variety of uses where it is essential to have the constituents intact

In this process the expelled shell liquid is obtained in more or less the same condition in which it exists in the nuts It consists in exposing bhilawan or cashew nuts in a closed vessel (A in Fig 1) to superheated steam at temperatures ranging from 150° to 300°C The vessel A is kept at a temperature of 150° to 200°C by a steam jacket J or electrical heating The expelled liquid is collected in a receiver R_1 through an outlet D_1 at the bottom of the vessel A and may be fractionated into (i) steam non-volatile, higher boiling fractions and (ii) steam volatile, lower boiling fractions The vessel A, in which the nuts are packed, is heated to 110° to 150°C prior to the letting in of the super-heated steam

The expelled shell liquid is comparable to that obtained by solvent extraction The process is, moreover, cheaper and quicker than hitherto known processes for obtaining the shell liquid

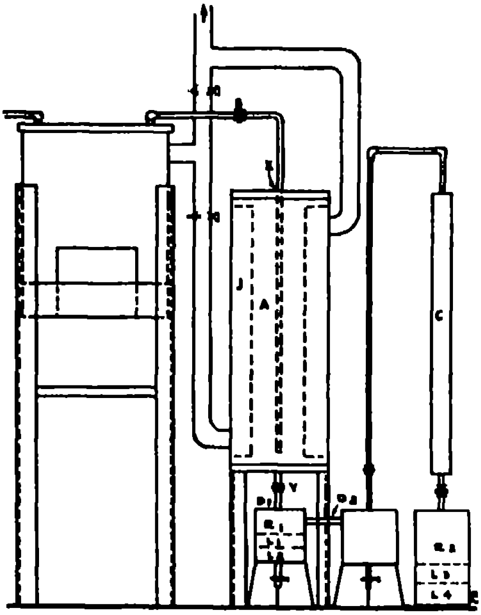

Fig 1

Patent No 34873

S Siddiqui & A A Khan

This patent is for an improved apparatus for the expulsion of liquid from the nuts or shells of bhilawan or cashew In the apparatus described

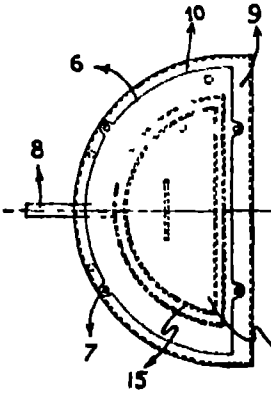

Fig II

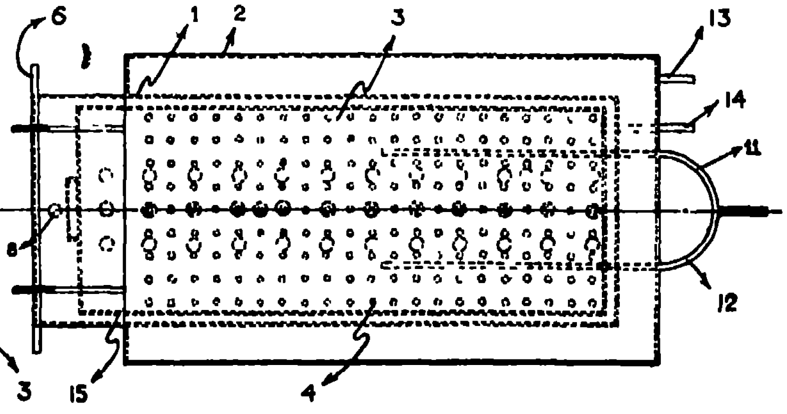

Fig. I

(continued on page 387)

Power Resources of India & Their Development

THE energy resources of India, according to the assessment of the Indian National Committee, are limited to coal and water power, natural gaseous fuels are non-existent and liquid fuel resources are negligible The extent of the energy resources of India and the problems of their development have been discussed in two important papers* submitted to the Fourth World Power Conference recently held in London It may be pointed out in this context that a survey of the power resources of different countries in the world reveals that there are but few countries which have truly large supplies of natural energy in the form of either fuel (coal and oil) or of water power, the natural resources of energy are unevenly distributed throughout the world. From the available data relating to India's resources, and the attention that is being paid to their conservation and planned development, India's position appears to be fairly satisfactory and there is justification for the hope that adequate power would be available to meet all the needs of future industrial expansion

Hydro-electric Power

"It has been estimated that India's ultimate water-power potential may amount to about 25×10^6 kW A systematic and comprehensive survey of the water-power potential of India has not yet been undertaken, since the cost of such a survey would be out of proportion to its practical value Nevertheless, many preliminary hydro-electric surveys have been undertaken, and the probable continuous capacity of water-power sites has been ascertained The total potential continuous capacity of such sites investigated amounts to 8.5×10^6 kW, of which only about 0.5×10^6 kW has so far been developed Since World War II, both Central and State governments have evinced considerable interest in the large-scale development of hydro-electric resources and it is evident that they intend to exploit them to the fullest extent of their financial capacity It is anticipated that projects likely to be implemented within the next ten years will probably total over 2.5×10^6 kW With the notable exception of the Tata Company, which still operates the biggest hydro-electric system in India, the State has already taken up the development of several major hydro-electric schemes This is in marked contrast to steam-power generation, which is mostly in the hands of private enterprise but is limited in its scope to urban areas The present policy of the Government aims at a large-scale electrification of rural areas from major hydro-electric power services interlinked by provincial grid schemes, with the result that responsibility for the generation and transmission of power may eventually pass largely into the hands of the State

The Development of Coal Resources

"The reserves of good coking coal in the country may not exceed 700×10^6 to 750×10^6 tons, and at the present rate of output these resources would be exhausted in about 65 years Workable coal resources in the Indian Union may be estimated at approximately 15,000 × 10^6 tons, but this estimate must be considered conservative, as prospecting in many parts, notably in Central India and Central Provinces, is still only in its infancy. The resources in the Karanpur field, even after allowing for a very large portion which is still only partially proved, are undoubtedly much larger than had ever been anticipated. It is believed, however, that there is no reason for anxiety over the resources of good quality non-coking coals, both high and low volatile, or of low-grade coals.

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* *An Assessment of Energy Resources and a Record of Their Development in India*, by the Indian National Committee, Paper No 12 Section A, Fourth World Power Conference, London, 1950

The Fuel Situation in India, by Dr J W Whitaker, Paper No 5, Section B1, Fourth World Power Conference, London, 1950

"The present output of coal is about 30 × 10^6 tons. There is no doubt that in the future, with the industrialization of the country, the consumption of coal will increase. The largest proportion of the coal raised is consumed by the railways. In the near future the railway consumption of coal is not likely to fall, but it is hoped that the *type* of coal utilized will be largely, if not entirely, *non-coking*. The public utility power stations use only a small percentage, but the direct consumption in industrial installations is quite substantial. Industrial works such as mills, factories and engineering works will, no doubt, increase, and their consumption of coal will grow correspondingly, while the amount required for electricity generation will similarly increase, especially in or near the coalfields. Bunker and export coal figures will also show an upper trend.

"The railways have made, and are making, efforts to increase their fuel efficiency and economy, and are investigating the possibilities of the powdered-coal gas-turbine locomotive. The climatic conditions in India are somewhat adverse and the coals themselves with their high ash content will be difficult to employ for this purpose unless suitable filters or separating cyclones capable of operating at high temperatures can be devised. Nevertheless, the problems are being attacked, as success will mean a reduction of coal consumption of about 50 per cent — a saving of Rs 7 or 8 crores per annum.

"In connection with powdered coal, many of the high ash coals of India can well be burned in this form at thermal electricity generating stations. The efficiency of such boiler plant is now very high, even when the ash content is as much as 50 per cent. This manner of utilization is a possible outlet not only for medium and lower-grade coals (whether coking or not), but also for the coal-washery refuse which has a high content of combustible matter.

"India's production of oil is only 6 per cent of her requirements, and in 1948 India imported about 589 × 10^6 Imperial gallons of mineral oils valued at 30 crores of rupees. In view of this position, attention has been given to the production of motor spirit and other fuels from coal by low-temperature carbonization and also by Fischer-Tropsch synthesis. The estimated coal consumption for making synthetic petrol in 1952 is nearly 2·25 × 10^6 tons, the consumption would eventually rise to about 3·25 × 10^6 tons."

Considerable attention has been recently devoted to the conservation of the limited resources of high-grade metallurgical coal and the more extensive utilization of non-coking coals. The Fuel Research Committee of the Council of Scientific & Industrial Research has initiated and sponsored many schemes of research bearing on beneficiation and utilization of low-grade coals. Indeed, the utilization of low-grade coals has now become a world problem. During the recent World Power Conference this subject came up for discussion. There is evidence that in many countries high-grade coal seams have been largely worked out and the quality of mined coal is falling from year to year. Mechanization has also contributed to the production of rather inferior grades of coal. More attention is, therefore, being diverted to the development of efficient methods of treating and using coal in the major coal-producing countries of the world. The work of the Fuel Research Committee, particularly on the washability and blending of coals, has yielded results of great practical value. The work on washability of coals has shown that many of the seams hitherto considered useless for coking are amenable to improvement by washing and are capable of yielding fractions quite suitable for coke manufacture. The work on coal blending has extended still further the possibilities of using coals hitherto considered unserviceable for coke manufacture. The Committee has undertaken other problems of research of far-reaching significance, among them the desulphurization of Tertiary Assam coals, coal blending and coking.

"In the matter of the development of coal resources, the Government of India fully appreciate the national importance of this problem. They have recently taken on hand the work of rationalizing the industry, and they are also taking steps to conserve the limited resources of high-grade metallurgical coal Among the possible lines of approach now under consideration, mention may be made of the following

(a) The enforcement of a programme for raising different grades of coal in relation to national requirements

(b) The electrification of major collieries with a view to mechanizing the various coal-raising operations

(c) The installation of large central power stations in order to achieve greater fuel efficiencies, and the consequent closing down of a large number of small industrial power plants

(d) The large-scale electrification of railways which will minimize the inefficient burning of coal in locomotives

(e) A restriction on the direct burning of high-grade coal so as to conserve supplies for metallurgical purposes "

Board of Scientific & Industrial Research
Twenty-fifth Meeting, New Delhi

THE twenty-fifth meeting of the Board of Scientific & Industrial Research was held in New Delhi on September 25, 1950 The meeting of the Governing Body of the Council was held on September 26 The Hon'ble Pandit Jawaharlal Nehru presided

The following eight new schemes of research were sanctioned by the Governing Body on the recommendation of the Board

1 Reaction kinetics of the vapour-phase thermal decomposition of mercury and zinc dimethyls Dr Lourdu M Yeddanapalli, *Madras*

2 Anti-bacterial and anti-fungal compounds from naphthalene Sri M L Khorana, *Bombay*

3 Production and properties of low carbon alloy steels containing manganese Dr Schrader, *Jamshedpur*

4 Production of aluminium metal by the electrolysis of molten anhydrous aluminium chloride Dr E G Ramachandran, *Bangalore*

5 Pilot-plant investigation on the production of power alcohol from bagasse Dr N R Kuloor, *Delhi*

6 Absorption of microwaves in the 3 cm region Dr Krishnaji, *Allahabad*

7 Investigations on R C coupled F M oscillator Dr H Rakshit, *Calcutta*

8 Recording and analysis of the reflection of electromagnetic waves from the ionosphere Dr K R Ramanathan, *Ahmedabad*.

The Governing Body of the Council of Scientific & Industrial Research recognized the untiring efforts of its Director, Dr Shanti Swarup Bhatnagar, in bringing into being the National Laboratories in the face of such difficulties, and recorded a resolution appreciating his services in the cause of scientific advancement in the country

The Council of Scientific & Industrial Research decided to call a conference of the Directors of the National Laboratories and the members of the Planning Commission to prepare a list of essential articles which are not produced in India and which would not be available in case of emergency, and to devise ways and means of producing these articles The Directors of the National Laboratories were requested to get into touch with industries for drawing up a list of problems to be investigated and for assigning priorities

The manufacture of synthetic petrol from raw materials available in the country was considered an important project demanding immediate attention The Council recommended to the Planning Commission to give immediate consideration to the report of the Committee appointed by the Council to go into this question and to give the project the highest priority in national planning The Committee, consisting of Mr J R D Tata, Mr G D Birla, Seth Kasturbhai Lalbhai, Lala Shri Ram, Dr S S Bhatnagar, Dr J C Ghosh and Dr D N Wadia, was requested to examine the question of importing crude oil and refining it in India and to submit their report by the end of this year

The Council of Scientific & Industrial Research decided to investigate the possibility of exploiting gypsum, copper pyrites and other resources for the production of sulphur and sulphuric acid In the absence of naturally occurring deposits of sulphur in the country, these projects should receive urgent consideration and the Council recommended to the Government of India to put up a pilot plant for the production of sulphur and sulphuric acid from gypsum

The establishment of a Regional Coal Survey Station at Kamptee in Madhya Pradesh was approved by the Board This station will work under the direction of the National Fuel Research Institute and will serve the Pench, Wardha and Chanda valleys and the Singareni coalfields The initiation of pilot-plant experiments at the National Fuel Research Institute on coal-washing, low temperature carbonization, production of coke from weakly coking coals, briquetting of coal and pressure combustion of powdered coal was approved A list of priorities is being drawn up for undertaking these investigations, and it has been decided to approach the Government of India and the industry for necessary funds

The Governing Body of the Council approved the constitution of the Board of Engineering Research and accepted its recommendation that the Council of Scientific & Industrial Research should conduct a survey to assess the facilities available for engineering research in India Five expert committees have been set up for civil, mechanical, electrical and radio, hydraulic and aeronautical engineering research aspects In view of the large number of hydro-electric and irrigation development projects under contemplation, the Board recommended that research in hydraulic engineering, with particular reference to machinery, should receive prior and urgent consideration

The appointments of Prof Charles Crussard as Director, National Metallurgical Laboratory, Jamshedpur, of Sir Edward Mellanby as Director, Central Drug Research Institute, Lucknow, and of Dr Ernst Zipkes as Director, Central Road Research Institute, New Delhi, were approved by the Governing Body

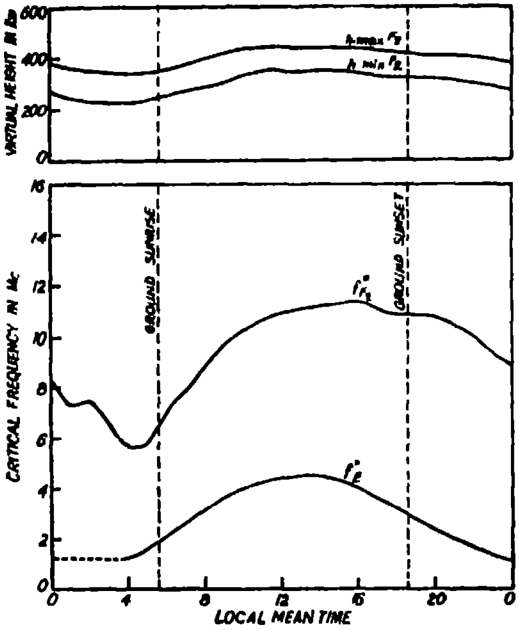
Characteristics of the Ionosphere over Calcutta (August 1950)

S S BARAL, R K MITRA, D C CHOUDHURY, A P MITRA & R B BANERJEE

Ionosphere Laboratory, Institute of Radio Physics & Electronics, Calcutta

THE following are the ionospheric data observed at Calcutta for the month of August 1950

The mean hourly values of the penetration frequency of region E and the penetration frequencies and virtual heights of region F_2 are represented in Fig 1 in graphical form The figures are obtained from average values of the data taken for each hour of the day for 5 days a week Fig 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of November 1950 Table I records the various occasions during routine observations when sporadic E ionization was observed and the corresponding values of penetration frequencies and heights.

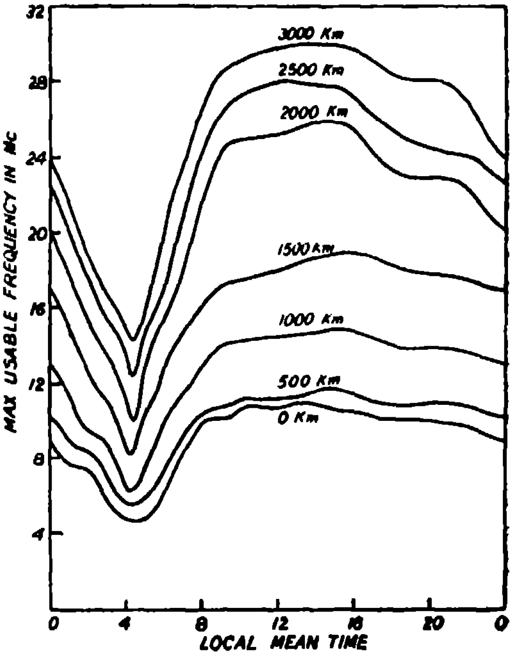


(5 HR 54 MIN AHEAD OF G M T)
FIG 1 — AUGUST 1950

Sporadic E ionization was found to occur frequently during afternoon and early part of the night in most of the occasions In the present month region F_2 ionization was found to rise slowly in the morning and the maximum value was reached in the afternoon No abnormality was observed in the region F during night time

TABLE I

MONTH & YEAR	DATE	HOURS L.M T	$f^\circ E_s$ Mc.	^hE_s Km.
August 1950	3	17 00	6 40	150
		18.00	6 00	150
		21 00	5 00	125
		22.00	3 55	120
	4	16 00	8 50	150
		17 00	8 00	150
		18.00	7 00	125
		21 00	6 25	120
	8	05.00	4 25	105
		06.00	4 50	105
		07 00	4 20	120
	11	16.00	4 20	120
		17 00	4 70	120
		18.00	4 90	105
		20 00	4 60	105
August 1950	12	07 00	3 90	105
		09.00	4 25	120
	16	17 00	4 50	120
		18.00	4 75	120
		19 00	5 00	120
		20.00	4 50	105
	21	17 00	4 70	120
	25	17 00	8 00	150
		18.00	3 25	135
		19.00	3 10	120
	26	08.00	3 50	105
	28	17 00	3 00	120
		18.00	3 20	120
	29	08.00	6 80	120
		10 00	6 95	135
		17 00	3 60	120
		21 00	3 45	120
		22.00	2 25	105
	30	09 00	6 45	120
		10.00	8 25	135
		18.00	3 85	120
	31	23 00	4 05	105



AT POINT OF REFLECTION
FIG 2 — PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF NOVEMBER 1950

The Central Food Technological Research Institute, Mysore— Opening Ceremony, October 21, 1950

THE Central Food Technological Research Institute, Mysore, was declared open on October 21, 1950 by the Hon'ble Shri C. Rajagopalachari. The Rajapramukh, the Maharaja of Mysore, presided.

Declaring the Institute open, Shri C. Rajagopalachari emphasized the need for technological research as a supplement to agricultural research for augmenting the food resources of the country and for maintaining proper nutritional standards. The Institute would, he observed, "make research in evolving suitable methods for the fortification of foods and the production of supplementary foods and dietetic accessories. All problems of food which require close and high level scientific research would fall within the orbit of the Institute." He paid a tribute to the zeal and organizing ability of Dr Shanti Swarup Bhatnagar "who has been the chief instrument in the establishment of many research institutes in our land at a great pace." He also announced the appointment of Dr V. Subrahmanyan as the Director of the Central Food Technological Research Institute.

The Prime Minister, Pandit Jawaharlal Nehru, in his message, referred to the opening of the national laboratories and research institutes as "one of the remarkable developments in India during the last three years." "We have put up some magnificent laboratories, not only impressive to look at, but I hope, the homes of productive effort and work. It is ultimately on the basis of work done in our research institutes and laboratories that we can progress in most directions. We have laid good and true foundation for scientific progress. It is for the young scientists of India to take advantage of the great opportunities offered to them and thus help in building up the new India.

"We have given top priority to the production of foodgrains or subsidiary foods. It is obvious that food is of the first importance and its value cannot be judged merely in money terms. We cannot depend on imports for our food and, therefore, we have laid down a target for food sufficiency. This is the 1951-52 season. In spite of all difficulties and disasters, we still adhere to that target and are trying to work up to it. We hope to succeed. It must always be remembered that food production has the highest priority.

"How can science help in this? The primary responsibility is of our Department of Agriculture. Science can help in agriculture greatly. It can also help in various other processes. It is more particularly with these other processes that this Institute will be concerned. I hope the work done in this Institute will bear fruit not in developments on paper and in scientific journals but in terms of human values and in increase of suitable food for our people. I look forward to good work being done there for the benefit of the nation."

The Institute is located in the magnificent Cheluvamba Mansions, which was given over to the Central Government as a gift.

The scope and functions of the Institute include development of improved methods of storage of different food materials, microbiological and biochemical changes attendant on various types of spoilage, reclamation and utilization of infested or otherwise affected food materials, and processing of foodstuffs with a view to improving their keeping quality and facilitating ready usage, refrigeration, freezing, gas storage, dehydration, canning, etc. The Institute will also study problems concerning food industries and food sanitation.

American Quest for Iron Ore

M S KRISHNAN
Director, Indian Bureau of Mines

THE United States of America is one of the few countries in the world which is endowed with large deposits of workable iron ore It is to the local availability of abundant ore and to improvements in technology in the fields of mining, treatment and transport that that country owes its supremacy as the largest producer of iron and steel in the world The production of pig iron in that country in 1943 amounted to over 62 million tons and of steel about 89 million tons

There are three chief iron-ore regions in the U S A , viz the Lake Superior district, the North-eastern region including the Adirondacks and the South-eastern region of Alabama, Georgia, etc In addition, there are also some scattered deposits in the Western States It has been estimated that the Lake Superior, the North-eastern and the South-eastern districts have each actual reserves of 1 billion tons of good ore The Lake Superior district, however, supplies about 85 per cent of the iron ore produced in the U S A , while the other two produce about 8 per cent and 4 per cent respectively, with still smaller quantities derived from the Western States But, owing to the rapid depletion of easily mineable high grade ores, that country is directing its attention far and wide to secure important iron-ore deposits which may be available in the countries bordering upon the Atlantic

World Reserves of Iron Ore

The latest comprehensive review of the iron-ore resources of the world is contained in a paper by Harry Mikami (*Economic Geology*, January-February 1944) Below is given a statement (TABLE I) which is a summary of this author's findings with regard to most of the countries on which data are available

The figures for proved and potential ores are of different orders of accuracy for different countries Those for U S A , Great Britain and Western Europe are reliable because a great deal of detailed work has been done by Governmental agencies and commercial interests In the case of South America, Africa and Asia the figures are only approximate and are likely to be greatly

TABLE I — WORLD RESERVES OF IRON ORE

After Mikami

	ACTUAL		POTENTIAL	
	Ore (million tons)	Iron content %	Ore (million tons)	Iron content, %
Canada	100	60	10,000	35
Labrador			1,000	60
Newfoundland	1,250	40	2,000	40
U S A	3 800	45	67,000	35
Mexico	100	60	100	
Cuba	3,000	40	12,000	
North America total	8 250		92,100	
France	4,500	35	6 000	35
Germany	800	32	2,000	30
Austria	200	35	200	
Great Britain	3,100	30	7 000	30
Norway	300	35	1,000	30
Spain	800	45	1,000	35
Sweden	1 250	62	1,250	60
U S S R	3 100	45	15,000	35
Others	620		550	
Europe total	14,670		34,000	
China	500	40	700	35
India	3 600	60	10,000	40
East Indies	100		1,600	
Philippines	500	47	500	
U S S R	1,400	45	2,400	
Others	280		335	
Asia, total	6,100		15,435	
Australia	400	60	?	
Brazil	4 000	60	11 000	40
Venezuela	100	60	1,000 +	45
Peru	100	60	?	
Chile	120	60	?	
South America, total	4,320		12,000 +	
Algeria	160	50		
Rhodesia			Large*	50
Sierra Leone	20	55	Large*	55
Fr Guinea			2,500	45
South Africa	1,000	55	7,000	45
Others	60		100	
Africa, total	1 240		12,000	
WORLD TOTAL	35,280		165,570	

* Included in the total

exceeded when the data attain the same degree of accuracy and detail as in the case of the U S A Taking India as an example, the estimate of high grade hematite ores in Bihar and Orissa given recently by Dr F G Percival of the *Tata Iron & Steel Co* is 8,000 million tons as against the previous estimates of 3,600 million tons This ignores the hematite and magnetite ores of Central Provinces, Mysore, Madras and Bombay whose total may amount to 3,000 million tons though the magnetite ores will require beneficiation In addition, large quantities of high and low grades may come to light if detailed drilling is undertaken Finally, we have enormous quantities of laterite in several areas, and especially over the Deccan traps, which contain 25 to 35 per cent iron and which at some future date will become economically workable

The iron content of the world total of the actual or proved iron ores is, according to Mikami, about 16 2 billion tons Of this 2 4 billion tons are in Brazil, 2 2 in India, 2 in U S S R , 1 7 in the U S A , 1 6 in France, 1 2 in Cuba, 0 9 in Great Britain, 0 8 in Sweden and 0 6 in South Africa

Of the above-mentioned countries, the U S A is consuming its reserves at a much faster rate than other countries The consumption increased to the abnormally high figure of over 100 million tons per year during the Second World War Table II gives the despatches of ore from the mines in the U S A and the part of Canada in the Lake Superior region, while Table III gives the steel production of important countries for 1939, 1943 and 1946

It will be seen from Table I that the most important resources are to be found in the U S A , Canada (including Newfoundland) and Cuba in North America , U S S R , Great Britain, France, Germany and Sweden in Europe , India and East Indies in Asia , Brazil and Venezuela in South America and South Africa and Sierra Leone in Africa

The Lake Superior region contains probably the richest group of deposits in the world There are several hill ranges in the States of Michigan, Minnesota and Wisconsin and also in the adjoining parts of Canada Of these areas the Marquette Range of Michigan was opened up in 1854 and later the Menominee, Gogebic, Vermillion, Mesabi and Cuyuna Ranges were discovered and opened up more or less in the order named

TABLE II — SHIPMENTS OF IRON ORE FROM MINES IN U.S.A. & THE LAKE SUPERIOR REGION OF CANADA

(In thousands of long tons)

	1942	1943	1944	1945	1946
Minnesota (Mesabi, Vermillion and Cuyuna)	75,900	69,971	66,586	62,831	50,010
Michigan and Wisconsin (Menominee Gogebic and Marquette)	17 700	15,991	15 270	13,180	9 578
Canada (Michipicoten and Steep Rock)	487	451	499	1,019	1,440
Total Lake Superior	94,496	86 413	82,355	76,980	61,020
North eastern (N Y , N J , Penn)	3 080	3,190	3 500	3,620	2,240
South eastern (Ga , Ala Tex Mo.)	9,210	8 530	7,400	6,660	6,450
Western (Wyo., Utah, N M , Cal , Ariz., Nev , Wash)	1,480	2,450	2,960	2,760	2,170
TOTAL	107 266	100,583	96,215	90,020	71,880

TABLE III — OUTPUT OF STEEL IN THE MORE IMPORTANT COUNTRIES

(In millions of long tons)

	1939	1943	1946
U S.A	47 1	79 8	59 5
Canada	1 8	2 6	2 1
United Kingdom	13 2	13 0	12 9
Sweden	1 1	1 2	1 2
France	7 8	5 0	4 3
Belgium	3 1	1 6	2 2
Luxembourg	1 8	2 1	1 3
Germany	22 0	30 0	2 7
Czechoslovakia	2 3	2 6	1 7
Poland	2 0	1 5	1 2
Italy	2 4		0 6
U S.S.R	18 5		18 0
Japan	6 6	7 7	0 6
India	1 0	1 4	1 2
Australia	1 2	1 7	1 3

Amongst these, the Mesabi Range is the most important and contains the famous huge open pit — The Hull-Rust-Mahoning — which is 3 miles long, 1½ miles wide and nearly 400′ deep and produces 30,000 tons or more per day On the Canadian side the well-known areas are Michipicoten, Steep Rock, Atikokan, Gunflint and Animikie which contain some important deposits In the Goulais river area the *Algoma Steel Corporation* has recently proved the existence of 50 million tons of magnetic ore which can be worked by open pit methods The Steep Rock deposits were opened up in 1942 by interests connected with *Cleveland-Cliffs Iron Co* and are producing increasing tonnages every year

The present estimates of reserves of workable ore in the chief areas of the United States are as follows .

Lake Superior Area — Direct shipping ores, 1,300 million tons, of which 800 million tons would be available for open pit mining The rest of the ore will have to be won by underground mining but its cost would be much higher than in the case of open pit mining At present the open pit mines are responsible for about 80 per cent of the production and the underground mines about 20 per cent The magnetite type ores of the North-eastern district in New York State and the hematite ores of the South-eastern district in Alabama State are estimated to amount to about 1,000 million tons each

Regarding the reserves of taconite, which is the low grade primary material of the iron formation, the proved ores containing 25 per cent or more iron have been calculated to amount to 467 billion tons (1 billion -- 1,000 millions) to a depth of 1,250′ in highly inclined strata and 400′ in gently dipping strata The potential reserves of taconite have been estimated at 67 billion tons (35 per cent iron), of which 12 billion tons are in the adjoining area of Canada As mining is now conducted in some places at a depth of 3,500′, the above estimates may need revision, but there may also be reductions to be made since some of the ores may not be amenable to beneficiation Taconite is a mixture of an iron silicate mineral with other minerals The iron silicate has been converted by natural processes into different proportions of hematite, magnetite and siderite The rich ore beds represent the completely altered and enriched taconite Taconite in general contains about 25 to 35 per cent of iron in the form of iron ore and in practice it would need 4 tons of taconite for recovering 1 ton of iron, after beneficiation and smelting

Taconite has, therefore, to be beneficiated in order to recover from it utilizable iron ore The process of concentration to be applied will depend on the mineral content and grain size When the ore mineral is magnetite, it can be crushed to a size of 100 to 200 mesh and the magnetite concentrated by electromagnetic separators If it consists of hematite, it may have to be crushed to 300 mesh, roasted under reducing conditions to convert the hematite into magnetite and the magnetite then separated Flotation has also been used to separate the hematite Since the concentrate is in a fine powdery form, it is agglomerated or pelletized so that the material becomes sufficiently hard and compact to be charged into furnaces Other processes like sintering and briquetting are also receiving attention

Beneficiation of taconite has been receiving attention since the early twenties, although it assumed urgency only during the last few years A plant for beneficiation was erected by the *Mesabi Iron Co* at Babbitt in Minnesota some 25 years ago but it was not successful Much work was also done in the Mines Experiment Station in the University of Minnesota under the direction of Dr E W Davis Encouragement has recently been given for the pursuit of this question by reduction of tax by the States concerned According to the new law, the beneficiated product will pay a tax of only 6 cents per ton at the time of shipping it away from the plant

Several of the steel producers and ore companies have been studying beneficiation during the last decade or so The Battelle Institute, the Mines Experiment Station at Minneapolis, *Picklands Mather, Hanna, Oliver, Jones & Laughlin, Cleveland-Cliffs, U S Steel* and others have been actively engaged in this research The State of Minnesota has also a research station at Hibbing

The *Erie Mining Co* (*Picklands Mather, Bethlehem* and *Youngstown Companies*) has a pilot plant for beneficiating magnetite-bearing taconite at Aurora This plant, which has a capacity of 200,000 tons per year, cost 2 million dollars The full-scale plant which will shortly be put up is expected to produce 2 5 million tons of agglomerated concentrates per year

The *Reserve Mining Co* (*Oglebay Norton, Armco* and *Wheeling*), which has large reserves of taconite, has plans to build a plant of 10 million tons finished product capacity per year, which will be composed of four units It is stated that the capital cost of mining equipment and beneficiation plant will be around $ 10 per ton of finished product for large-scale production

An important requirement in beneficiation is the reduction of the silica content in the concentrate to 12 per cent or less This necessitates fine grinding to −300 mesh for most taconites If a concentrate containing up to 15 per cent silica would be acceptable to the steel industry, the solution of the problems will be easier Magnetic roasting is another important problem which is being attacked vigorously in order to reduce cost Magnetic separation of fine materials is also beset with difficulties and studies are under way for better control of the magnetic fields and better separation as well as for quicker demagnetization Flotation is an effective process in ores containing crystalline hematite and research is leading to the reduction of costs

There is no doubt that in the course of another 2 or 3 years appreciable tonnages of taconite concentrates will be used by the smelters It is expected that, as the natural ores of Lake Superior get depleted, the production of taconite concentrates will rise to 20 or 30 million tons per annum

Recent Improvements in Technique

In the large pits like Hull-Rust, the ore is loaded direct into railway wagons by power shovels, the pits being large enough for taking down a regular train into them In the smaller open cast operations, large trucks are generally used for the transport of ore The power shovels have buckets with capacities ranging usually from 4 cu yd to 7 cu yd In 1941, only about 100 heavy duty trucks for haulage of ore were in operation but in 1949 the number has increased to about 700 The capacity of the trucks, which was originally 15 tons, has been enlarged to between 20 and 30 tons, while 40 ton units are now undergoing trials A number of belt conveyers are in operation for hoisting the ore from the pits, the usual width of the belt being 30″ and the length varying a great deal, from about 200 yards to as much as a mile The lift of the ore ranges up to a maximum of 380′ while the speed of the conveyer varies usually from 500′ to 550′ per minute Much work has been done to improve the quality of belts and a belt life of 6 to 10 million tons ore haulage has been achieved

At present, about 30 per cent of the ore won in the Lake Superior region undergoes some process of beneficiation, not so much for any considerable improvement in grade, but for supplying the smelters with a uniform grade over a long period The average ore shipped has an iron content of 51 to 54 per cent

The most common mode of concentration of ore is by means of heavy-media separation The newest equipment in this line is the Hardinge counter-current separator which has proved quite satisfactory A great deal of fine ore of ¼″ to ⅛″ size is now being successfully separated and utilized Classifier overflows are treated by Dorrco sizers in order to recover the fines The Dutch State cyclone separators have also been recently installed and their usefulness is being studied Other processes in use are new type of jigs, washing in Humphrey spirals and flotation

Present Sources of Iron Ores

There are some 10 major iron and steel companies in the U S A with steel ingot capacity varying from 1 5 million tons to 31 3 million tons per year Of these the largest is the *United States Steel Corporation*, the others being *Bethlehem*, *Republic*, *Jones & Laughlin*, *National*, *Youngstown Steel & Tube*, *Armco*, *Inland*, *Sharon* and *Wheeling Steel Companies* Most of these have their own mines but practically all buy also heavily from iron-ore mining companies, the chief of which are *Picklands, Mather & Co*, *Cleveland-Cliffs Iron Co*, *M A Hanna & Co*, *Oliver Iron Mining Co* and *Oglebay Norton & Co* (*see* TABLE IV) The *U S Steel Corporation* has the largest reserves in the Lake Superior area, *M A Hanna & Co* coming second in importance in their holdings The *Oliver Iron Mining Co* is a subsidiary of the *U S Steel Corporation* *Picklands, Mather & Co* manage iron-ore mines for *Bethlehem* and *Youngstown* interests and are also part proprietors and managers of the *Erie Mining Co* which will process increasing tonnages of low grade ores A firm called the *Reserve Mining Co* is operated jointly by *Oglebay Norton & Co*, *Armco* and *Wheeling Corporations* *M A Hanna & Co* is affiliated with *National Steel* and is now an important factor in the development of new ore fields in Labrador Table IV gives at a glance the present as well as future sources of ore which will feed the steel industry of the United States

Even in the early part of this century, before the First World War, it was considered that the Lake Superior deposits were almost inexhaustible It is said that in 1913 the *U.S. Steel Corporation*, which was the holder of the largest reserves, gave up some of its holdings containing well over 300 million tons Even in later years, perhaps because of the heavy tax burdens on ore reserves,

TABLE IV

Steel companies and ingot capacity (million tons)	Present source of ore	Mining companies supplying ore to steel companies					Future sources of ore
		Pickands Mather & Co	*Cleveland Cliffs Iron Co.*	*M A Hanna & Co.*	*Oliver Iron Mining Co*	*Oglebay Norton Co.*	
U S Steel Corporation (31 3)	Lake Superior Alabama, Utah				×		Taconites and Venezuela
Bethlehem Steel Corporation (14 2)	Lake Superior Penn, Chile, Cuba	×	×		×	×	Mexico, Cuba, Venezuela, Chile and taconites
Republic Steel Corporation (4 8)	Lake Superior Alabama, Adirondack		×		×		Labrador Liberia
Jones & Laughlin Steel Corporation (4 8)	Lake Superior, Adirondack						
National Steel Corporation (4 2)				×	×		Labrador
Youngstown Steel & Tube Co (4 1)	Lake Superior	×			×		Labrador and taconites
Armco Steel Corporation (3 6)	Lake Superior			×	×	×	Labrador and taconites
Inland Steel Co (3 4)	Lake Superior			×	×		Ontario
Sharon Steel Corporation (1 7)					×		
Wheeling Steel Corporation (1 5)	Lake Superior			×	×	×	Labrador and taconites

NOTE (✓) indicates the ore supplier (or subsidiary) to the steel making firm against which it occur

some of the other companies are reported to have wished that they did not have as much reserves as they possessed at that time' But, after the Second World War, by the end of which the reserves of the easily mineable ore had been seriously depleted, came the realization of the possible shortage in the near future At the end of 1949, the reserves of direct shipping ores of the Lake Superior region were estimated to be only 1,290 million tons, about 53 5 per cent of this (690 million tons) being held by the *U S Steel Corporation* Some of the other companies are badly off as they hold less than 40 million tons each The present reserves of the high grade ores will last only some 20 years by which time the shortage will have to be met by foreign ore or by beneficiated taconite The annual consumption of steel in the immediate future is expected to be of the order of 90 million tons, for which over 100 million tons of good ore will have to be supplied It is, therefore, that, since the Second World War, the search for new deposits and research on beneficiation of taconite had been greatly intensified and accelerated Most of the countries bordering the Atlantic Ocean have been searched and good deposits located, especially in Canada, West Indies and Venezuela

The following figures of local output of iron ore in the U S A and imports from other countries will give an idea of the present sources which supply ore to the U S steel industry The figures refer to the year 1949

DOMESTIC PRODUCTION

	Tons
Lake Superior region	68,927,000
South-east area	7,444,000
North-east area	3,778,000
Western area	4,238,000
Other areas	594,000
TOTAL	84,981,000

IMPORTS

Country	*Tons*	*c i f per ton,* $
Algeria	415,501	5 53
Brazil	354,509	6 59
British W Africa	49,648	6 03
Canada	1,595,518	6 63
Chile	2,627,007	2 62
Cuba	11,589	2 14
Mexico	169,823	1 68
Netherlands	7,114	9 00
Philippines	4,250	9 96
Spain	9,200	8 55
Sweden	2,047,343	6 42
Tunisia	82,815	5·12
South Africa	9,900	9 68
TOTAL	7,384,217	

In addition to this, about 10,000 tons were imported, mainly for paints or for research purposes, from various sources.

Discovery & Development of New Deposits

Chile — The El Romeral deposits in Chile are estimated to contain reserves of over 20 million tons The *Bethlehem Steel Corporation* has already taken up the development of these deposits and 2 6 and 2 7 million tons respectively were shipped during 1948 and 1949

Cuba — This island contains large deposits of lateritic ore, most of which will need beneficiation Some small ones in the Pinar del Rio province may contain a few million tons of direct shipping ore The value of the lateritic deposits lies, however, in their containing nickel and chromium The *U S Steel Corporation* and certain other companies hold concessions in Cuba and will take steps to utilize them in future

Liberia — Search in the African Republic of Liberia by private interests and by the U S Geological Survey brought to light the presence of some good deposits of iron ore in the north The deposits have been leased to the *Liberia Mining Co* , the control of which is in American hands The ore is generally a mixture of hematite and magnetite containing 68 per cent iron and low phosphorus, sulphur and silica The ore is hard so that it can be fed into furnaces as lumps At least 20 million tons of high grade and an additional tonnage of low grade ore have been proved The *Republic Steel Corporation* has acquired an interest in the *Liberia Mining Co* A railway, 45 miles long, is being constructed from the deposits to Monrovia, the capital and chief port in the State, where harbour facilities are being provided to handle about 1 million tons of ore per year Shipments of ore are expected to start in 1951

Mexico — Mexico has several deposits of iron ore, some of them of fair size, but it is doubtful whether any of them are held by American companies It is stated that the *Bethlehem Steel Corporation* has control over the La Truchas deposits near the western coast

Brazil — A good deal of attention has been paid to Brazil by American companies for over two decades Brazil itself has a small iron and steel industry but its rapid development is hampered by the absence of good coking coal in the country Some Brazilian ore is imported by the U S A Incidentally, research has brought to light some excellent manganese ore deposits One of these, in the Urucum Mountains, 15 miles south of Corumba in the State of Matto Grosso, is said to contain at least 27 million tons of ore of 46 per cent grade The *U S Steel Corporation* is developing this deposit for an annual production of at least 100,000 tons

Quebec-Labrador — Iron ore was discovered in 1929 in Labrador, which is a cold ice-covered region for half the year, but the first company to explore the area, called the *Labrador Mining & Exploration Co* , was formed only in 1936 An area of 20,000 sq miles was taken up in Labrador and some 3,900 sq miles in the adjacent area of Quebec where it was expected that the ore deposits would continue In 1942, *Hollinger Consolidated Gold Mines Ltd* acquired control of the above-mentioned company and a new company was formed called the *Hollinger North Shore Exploration Co Ltd* to undertake exploration in the area lying in Quebec (3,900 sq miles) *M A Hanna & Co* also came into partnership with *Hollinger* in the same year, the combine being called *Hollinger-Hanna Ltd* Exploration began in earnest only in 1947 A little later in 1949, the *Iron Ore Co of Canada* was formed for taking in hand further developments, the partners in this being the *Republic National, Armco, Erie* and *Youngstown* steel interests Agreement has been reached regarding the areas which would be exploited on behalf of the steel interests, reserving certain other areas for the Canadian steel industry and for any export of ore which Canada may wish to make

In addition to the *Hollinger-Hanna* interests already mentioned, there are also others who have taken concessions in the adjacent areas of Quebec and Labrador To the north-west are *Norancon Exploration* (*Quebec*) *Ltd* controlled by Noranda, Anglo-Huronian and Conwest the *Fort Chimo Mines Ltd* (Frobisher interests) and the *Quebec-Labrador Development Co Ltd* , while in the Labrador area are *Norancon Exploration Ltd* , *Dome Exploration* (*Canada*) *Ltd* and *Kennco Exploration Ltd* (*Kennecott Copper Co* and *New Jersey Zinc Co*) The last of these hold deposits of ilmenite and titaniferous magnetite in which they have proved 50 million tons of ore containing 35 per cent titanium They will be spending 25 million dollars to develop the deposits and 15 million dollars to construct an electric smelting plant of 1,500 tons capacity (initial) per day The smelting plant is

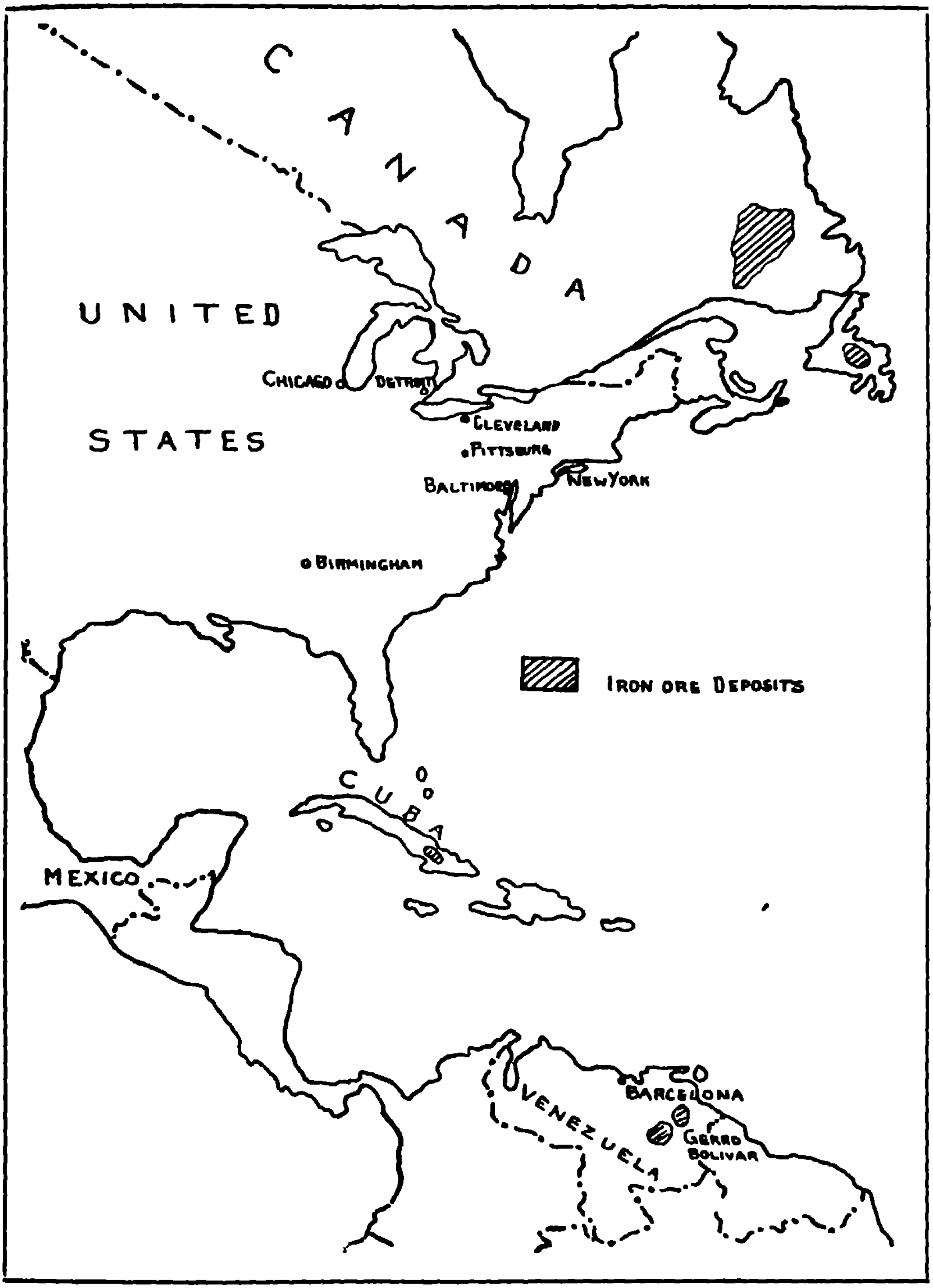


FIG 1 — NEW DEPOSITS OF IRON ORE IN CANADA AND NORTH AND SOUTH AMERICA

scheduled to start in 1951 at Sorel in Quebec. Pig iron, which will be got as a byproduct, may amount to 200,000 tons per year, containing 97 per cent iron, 2 per cent carbon, 0·1 per cent silicon, 0·2 per cent titanium, 0·03 per cent phosphorus, 0·1 per cent or less sulphur, 0·04 per cent manganese, 0·05 per cent chromium and 0·05 per cent vanadium. The *Fort Chimo Mines Ltd* have secured an area of 1,000 sq. miles in which the ore zone is 35 miles long. They will apparently move the ore to Fort Chimo which is 100 miles from the deposits and thence by ship.

The geological structure in which the ore occurs is called the Ungava trough, 350 miles in N.W.-S.E. direction, but the formations are expected to continue beyond the structure in both directions. The area is covered with a thickness of 5′ to 20′ of glacial deposits which accounts for the scarcity of outcrops and for the ores being unrecognized until recently. There are numerous individual deposits in the iron formation, each containing a few million tons, and some quite large.

The deposits in Labrador and Quebec, so far as they have been explored by *Hollinger-Hanna*, appear to hold enormous reserves at and near the surface. A rich zone, 90 miles long, has already been disclosed and there are prospects of this being extended further. By the beginning of 1950, exploration has revealed the presence of at least 400 million tons of high grade iron ore which can be mined open-cast. So far, only 5 per cent of the area is said to have been properly investigated, so that the possibilities of blocking huge reserves are excellent. In the explored area, the deposits are 100 to 300 yds wide and in most places 200′ thick, while one drill hole is said to have gone through a thickness of 367′ of high grade ore without reaching the bottom of the ore. Apparently, different types of ore are available, some containing over 60 per cent iron while others are lower in iron and contain appreciable manganese.

Typical analyses of ores from Quebec are

	Bessemer, %	*Non-bessemer,* %	*Manganiferous,* %
Iron	61·9	57·9	52·1
Manganese	0·44	0·59	6·85
Phosphorus	0·030	0·106	0·121
Silica	6·35	7·80	6·23

Arrangements are afoot to construct a railway, 360 miles long, from the deposits to Seven Islands where the ore will be put on ocean-going freighters for being transported either to the works in the Great Lakes area or to the eastern sea-board of the U.S.A. The capital expenditure on railway, power development (there are excellent chances of developing 3 million h.p. water-power in the area), mining equipment, transportation facilities, etc., will be of the order of 200 million dollars, while improvements to the waterway for navigation purposes will cost about 400 million dollars. The latter will be mainly devoted to the widening and deepening of the river route between Montreal and Prescott where, at present, the river can take only vessels with 14′ draft. It is expected that this will be deepened so as to provide for vessels with 30′ draft. When these improvements have taken place, *Hollinger-Hanna* will probably ship 10 million tons of ore per year from this area, and other interests may also ship further substantial quantities.

Venezuela — One of the regions which received a great deal of attention during the last decade was the lower part of the Orinoco drainage basin south of the Orinoco and east of its tributary Rio Caroni. There are several deposits of good iron ore here over a length of some 100 miles. The aggregate tonnage in all the deposits may be of the order of 200 to 300 million tons, but individual deposits are only of moderate size, containing from a few million to 50 million tons. The *Bethlehem Steel Corporation's* El Pao deposits are said to contain some 50 or 60 million tons, a part of which can be won by open pit methods. *Hanna & Co* as well as the *U.S. Steel Corporation* have some concessions in this region near El Pao, La Grulla and Piaoca. The *Bethlehem Steel Corporation* has constructed loading facilities at Palua on the Orinoco. The ore will be sent to Palua by rail and thence by large barges to Puerto Hierro near Guiria on the northern shore of Gulf of Paria where the ore will be transferred to ocean-going freighters. *Bethlehem* hopes to move 2 to 3 million tons of ore per annum from the Venezuela deposits and its plans will cost more than 50 million dollars in the provision of various facilities necessary for mining and transport.

The El Pao-La Grulla area has been declared a "Federal Reserve" by the

Government of Venezuela and in this "reserve" leases can be given only for a period of 40 years The region has been fairly thoroughly searched and its potentialities gauged *U S Steel Corporation* held only small reserves here which were not sufficient to meet its long-term requirements. It was the general opinion that other areas in Venezuela did not contain iron ores However, the *Corporation* thought it worth while to explore the area south of Orinoco and west of Rio Caroni which had so far not received any attention The region was soon gone over by plane and aerial photographs taken The photographs revealed two small ranges of hills locally known as Arimagua and La Parida within 30 miles of each other and 50 miles south of Ciudad Bolivar Since these hills were thought to be worth examination, in the summer of 1947, a field party was organized to go over the ground, examine the two hills and to conduct a magnetic survey The work revealed extremely high magnetometer readings which were interpreted as showing the existence of rich deposits of iron ore Soon after, two diamond drills were sent over to the La Parida and drilling confirmed the magnetometer observations Three groups of areas, Altamira, Arimagua and Rondon, were demarcated and the *U S Steel Corporation* applied for leases over them, totalling about 18,000 acres As these areas lay to the west of Rio Caroni, they were outside the Government reserve and it was possible to obtain longer leases, for 100 years.

La Parida proved to be a really rich and spectacular find and systematic drilling was conducted through 1947 and early 1948. The hill is somewhat smaller in area than the famous Hull-Rust-Mahoning property in the Lake Superior region The ore bed is about 18,000′ long with an average width of 1,200′ The ore analysed over 63 per cent iron, 0·11 per cent phosphorus, 0 005 per cent sulphur, 2·29 per cent silica, 1·53 per cent alumina, 0·10 per cent manganese and 0 135 per cent titanium The average depth of the ore was determined as around 150′. The ore reserves are probably in excess of 1,000 million tons and *U S. Steel Corporation* has been granted lease of 100 years' duration so that it can plan development on a long-term basis La Parida has now been renamed Cerro Bolivar.

The *Corporation* has been carrying out surveys for a railway which will lead nearly straight north to the coast near Barcelona, a distance of 274 miles If this proves satisfactory it will be used for hauling some 15 million tons of ore per year, each train carrying about 10,000 tons of ore. This railway will need a large bridge, about 4½ miles long, across the Orinoco near the city of Ciudad Bolivar There is a port at Barcelona, but it will have to be improved in order to enable this large tonnage to be handled properly The construction of the railway and improvements to the harbour are expected to cost over 110 million dollars. An alternative plan is also under consideration This will involve the construction of a railway, 90 miles long, from the Cerro Bolivar deposits to the river bank near the confluence of the Orinoco and the Caroni. From there the ore will have to be carried down the Orinoco and its branch, the Macareo The *Corporation* is planning to transport the ore to America in giant ships which will have a capacity of 45,000 tons Such a project would necessitate the deepening of the river to a depth of 34′ to 38′ so that large ocean-going freighters can go to the point of loading on the river The railway is expected to cost 50 million dollars while the dredging of the river will cost 18 million dollars with an annual maintenance charge of over 1 million dollars The distance to be dredged along the river is 170 miles. Even with all this expenditure, it is expected that the ore obtained from Cerro Bolivar can be landed at Baltimore on the Atlantic shore of America at a price approximating to that of the Labrador ore. Only the high grade direct-shipping Lake Superior ore will be cheaper, but beneficiated taconites will definitely cost more It is expected that in about another decade the *U S Steel Corporation* will be drawing between 10 to 15 million tons from Cerro Bolivar and probably 10 million tons of beneficiated taconite from the Lake Superior region The latter project, i e the beneficiation of taconites, is expected to cost more than 600 million dollars to this *Corporation.*

The *U S Steel Corporation* has also secured some concessions in the Piacoa and La Grulla areas in the Government reserves, east of Rio Caroni These deposits contain ores of variable composition and are much smaller in size than those of Cerro Bolivar.

The comparative costs of ore from the different areas, as estimated by Lippert (*see* reference at the end of the paper), are given below. This is based on the standard value of $7.20 per ton of Mesabi (Lake Superior) non-bessemer ore at ports on the Lake Erie. Out of this, the shipper gets $4.71 after paying rail and water freight.

Ore	*Iron content* %	*Natural iron,* %	*Lake Erie price* $	*Price per unit of iron, cents*
Labrador	59.3	53.4	7.72	14.5
Venezuela	63.8	59.0	8.54	14.5
Taconite nodules (Lake Superior)	65.4	65.0	9.40	14.5
Natural ore (Lake Superior)	58.2	51.1	7.14	14.0

It will also be useful to compare the distances from some of the sources to the industrial areas in the United States. This is given below.

	Miles
Labrador	
Deposits to Seven Islands (rail)	360
Seven Islands to Erie ports (water-way)	882
or Seven Islands to Baltimore (ocean)	1700
Mesabi Range (*Lake Superior*)	
From deposits to Duluth (rail)	92
Duluth to Erie ports (water-way)	837
Duluth to Baltimore (water-way and ocean)	3417
Venezuela	
Cerro Bolivar to Orinoco river port (rail)	91
Orinoco river port to mouth of river (water-way)	170
Mouth of river to Baltimore (ocean)	2280
or Cerro Bolivar to Barcelona (rail)	274
Barcelona to Baltimore (ocean)	2190
Barcelona to Mobile (ocean)	2190
Mobile to Birmingham, Alabama (rail and water)	280
Liberia	
Deposits to Monrovia port (rail)	45
Monrovia to Baltimore (ocean)	3900

Conclusion

This story has some moral lessons for us in India. Our resources of high grade iron ore (containing over 60 per cent iron) in Bihar and Orissa are estimated to be of the order of 8,000 million tons, but this should not lead us to believe that the deposits are inexhaustible, as the Americans thought of theirs barely 30 or 40 years ago. It is necessary for us to take a long view and adopt all measures of conservation so as to prevent waste in mining and to plan long-term utilization. I remember that some years ago a mining engineer of an iron and steel-making firm in India told me that his company would not bother to work and charge into the furnace iron ore containing less than 63 or 64 per cent iron. It is, of course, easy to do this when there is plenty of such ore, but even if his company held 100 years' supply at the present rate of consumption, the reserves will contract considerably if it expands its production. At present, some very high grade powdery ore (containing as much as 65 to 68 per cent iron) is occasionally mined but it is, so far as I know, not utilized just because it will cost the companies something to convert it into an agglomerate or sinter before use. Again, it would be well worth working a certain amount of low grade ore and mix it with high grade ore so as to be able to maintain an average of a moderately high grade, say 58 to 60 per cent, over a long period of time rather than exhaust the high grade ores and progressively go down to the lower grades. This is exactly what has happened in America. In the latter part of the last century and the early years of the present century there was still plenty of 60 per cent ore available in the U.S.A., but that time is now past and the average ore now shipped analyses to only 52 to 53 per cent iron. To maintain even this average, it is apparently necessary to beneficiate about a third of the total production of the Lake Superior ores.

It would, therefore, seem worth while to learn from the experience of other countries and adopt all possible measures of conservation in India, even though, at present, the resources might appear to be very large and even inexhaustible. The availability of these large resources gives hope of our being able to expand the production of steel to, say, 10 million tons per year in about 15 years' time and perhaps 20 million tons in about 25 years' time In order to do this, we shall have to utilize our resources in the most careful manner All countries have passed through a stage of prodigality in utilizing nature's bounties, but sooner or later the realization comes that such wastefulness is harmful to the long-term interests of the country It behoves us, therefore, to use our resources wisely and well

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Professor Charles Crussard

THE APPOINTMENT OF PROF CHARLES Crussard as the Director of the National Metallurgical Laboratory, Jamshedpur, has been announced

Born in 1916 of an old family of scientists, Prof Crussard entered Ecole Polytechnique, Paris, in 1934 and graduated at the head of his class After that he had two years of further studies in the School of Mines in Paris and also obtained his degree from the University From then on he has been mostly engaged in research He spent one year in the Metallurgical Laboratories of the steel-works of the French Navy and then worked under eminent scientists like Prof Chevenard and Dr Jolivet

In 1942 Prof Crussard was appointed the first Director of the "Centre de Recherches Metallurgiques de l'Ecole des Mines", a research laboratory sponsored by the School of Mines and the French steel and aluminium industry In 1945 Prof Crussard was sent on a 5-month mission to U S A to see the wartime developments of the metallurgical processes and techniques. He has been a member of committee for the establishment of the IRSID laboratory, a research organization under the French Steel Industry Committee He was specially charged with the planning of the Physical metallurgy laboratory, the construction of which has just started He was appointed Professor of Physical Metallurgy of the School of Mines in 1948 and is mainly interested in the physics of metals He has published numerous papers of his researches on plastic properties, creep, recrystallization, electrical properties, heat treatment, etc, of metals and alloys

PROF. CHARLES CRUSSARD

Magnetic Resonance Absorption in Microwave Spectroscopy

A PANDE[*]
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WHEN a paramagnetic salt is placed in a magnetic field, absorption lines are observed in the microwave region corresponding to the Larmor precession frequency of the resultant electron spin of the paramagnetic ion. This was first observed by Zaboisky[1] and by Cummerow and Halliday[2]. The orbital momentum vector is quenched by the internal electric field and the spin vector alone is left to act about the applied magnetic field. This mechanism by which the orbital angular momentum is quenched and the spin left free is generally accepted to be the Stark splitting of the orbital states of the ions by the electric field.

Such Stark splittings have been observed in the case of chrome alum by Weiss[3]. Also the Stark splitting and g factors of the ground state has been evaluated by Whitmer, Weidner, Hsiang and Weiss[4] from the position of the absorption peaks. They also have extended the theory for the computation of the Stark splitting to extend to include (110) orientation. Similar computations have been made independently by Kittel and Luttinger[5] for chrome alum for the (100) orientation. Due to the energy levels the free ions are broken down making it possible to observe the magnetic dipole transitions even without an external magnetic field.

Gorter and his co-workers have investigated the absorption in paramagnetic substances at low frequencies and without any applied static magnetic field. Equipment limitations prevented their reaching frequencies of the order of the reciprocal of the time of relaxation. Kip and Arnold at *M.I.T.* have improved on this method with a view to studying the nature of paramagnetic relaxation. Absorption has been measured by observing the change in Q of a resonant cavity in which a sample was placed. They made a single re-entrant cylindrical cavity, the frequency of which could be changed in steps from 300 Mc/s to 480 Mc/s. Measurement of Q is accomplished by comparison of the power transmitted through a calibrated attenuator.

Bleaney and Penrose[6] have studied the crystalline Stark splitting of paramagnetic resonance absorption in ammonium chrome alum as a function of temperature. They found the Stark splitting to decrease linearly with decrease in temperature until a temperature of about 85°K was attained when a sharp discontinuity occurred representing a large increase in the splitting at lower temperatures. They think that the discontinuity is due to a realignment of the crystalline field at such a low temperature. A common property of the salts of the hydrated iron group is that the spin of the paramagnetic ion is free to orient itself in a magnetic field, but that is not the case in an electric field. The lack of freedom of the spin in orienting itself also has the consequence that the Curie-temperature, computed from the susceptibility of the salt on the supposition that the spin is perfectly free, is not the true temperature. Some estimates of these have been computed by Van Vleck on the basis of the assumed distributions of charges in the neighbourhood of the paramagnetic ion.

Weiss has computed the splitting due to electric field in the case of ammonium chrome alum from measurements made at room temperatures on the resonance absorption at 3·20 cm. His analysis shows that the g value of the chromic ammonium sulphate is 1·97 and the splitting can be explained by the assumption of cylindrical electrical field, the magnitude of the splitting being $\delta = 0{\cdot}15 \pm 0{\cdot}01^{-1}$ cm. The constants of the electric field are found to be $\bar{Q} = 1500^{-1}$ cm and $\bar{a} = 180^{-1}$ cm. The corresponding quantities computed by Van Vleck are 1000^{-1} cm. and 60^{-1} cm respectively.

Resonance absorption in potassium copper sulphate has been used by Kip and Arnold as a method of investigating qualitatively the exchange coupling between the two paramagnetic ions in the unit cell of this salt. There is found to be appreciably less exchange coupling in the $K_2Cu(SO_4)_2\,6H_2O$ than in $CuSO_4\,5H_2O$ previously investigated by them. They built an optical apparatus by means of which a crystal can be accurately oriented with respect to a static magnetic field in a microwave resonant cavity. The crystal is first oriented by optical methods and is then transferred in a way which preserves the orientation to the rotatable polystyrene shaft which holds the crystal at the centre of the microwave cavity. Their measured values of *g* were found to be slightly different from those from magnetic susceptibilities. They found two separate absorption peaks corresponding to two tetragonal axes of different orientations which give two different *g* factors. In a similar experiment on $CuSO_4\,5H_2O$ there was *but one absorption* peak located at the mean of the two expected resolved peak positions. This is explained as a result of exchange coupling between the two cu^{++} ions. Exchange coupling is much less in $K_2Cu(SO_4)_2\,6H_2O$ in which Cu^{++} ions are more dilute.

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Magnetic resonance has been observed in the case of ferromagnetic substances as well, but the work in this is comparably less. This was first observed by Griffiths and confirmed by Yager and Bozorth[10]. They found that the observed frequencies in ferromagnetic materials were several times greater than those predicted theoretically for Larmor frequencies of electron spins. This ferromagnetic resonance phenomenon is the analog of the Purcell Torrey-Pound nuclear resonance experiment. Griffiths tried to explain this anomaly in the frequency by the assumption of Lorentz cavity force.

Kittel[11] showed that this assumption is not justified and has given an excellent theoretical interpretation of this anomalous Larmor frequencies. He showed that it is important to consider the dynamic coupling caused by the demagnetization field normal to the surface of the specimen, with the result that the appropriate Larmor frequency in such a case should be calculated using field strength $= (BH)^{\frac{1}{2}}$ instead of H as in the paramagnetic case. According to Kittel, Larmor frequency W_0 is given as

$$W_0 = \gamma\,(BH)^{\frac{1}{2}}$$

where γ = gyromagnetic ratio and
$(BH)^{\frac{1}{2}}$ = fictitious field.

Kittel calculated the Larmor frequencies of Fe, Co, Ni and found very good agreement with the experimental values as given below.

Angular Frequencies for Resonance $\times 10^{-10}$

	D C field	*Calculated values*		*Experimental frequencies*
		For H	*For* $(BH)^{\frac{1}{2}}$	
		Mc/s	Mc/s	Mc/s
Fe	2800 (oe)	5·0	14·5	15·4
Co	510	0·9	5·3	5·9
Ni	5000	8·8	13·5	15·4
	3800	6·7	10·9	13·2
	1030	1·8	4·9	5·9

Later Kittel showed that the correct form of the Larmor theorem depends on the shape of the ferromagnetic material used. For a small sphere the usual form $W_0 = \gamma H$ gives satisfactory values. He took the gyromagnetic ratio as equal to the electron spin value.

Yager and Bozorth have designed experiments to test Kittel's theory and to evaluate the gyromagnetic ratio. They chose experimental conditions to suit the simplifying assumptions made in Kittel's theory. They used supermalloy which has very low crystal anisotropy and is probably the most easily saturable material. The static field was applied in the plane of the foils and at right angles to the r f magnetic field. The rosonant frequency of the cavity for the dominant mode of the wave guide was 24,050 Mc/s. They observed a sharp resonance at an applied field of 4,950 oersteds corresponding to H = 4,920. This gives a value of 2·17 for Lange's splitting factor *g*. This value is considerably higher than the value 1·91 reported by Barnett[12] for an alloy of similar composition. A value of *g* greater than 2 is not expected and hence Yager and Bozorth conclude that a refinement of Kittel's theory is required.

Kip and Arnold found that value of *g* without using the value of the saturation magnetization M in the equation

$$h\nu = g\,(BH)^{\frac{1}{2}}\,M$$

where B is the Bhor magnetron. They attempted to eliminate the use of M by measuring the resonance absorption at two frequencies. Runs were made at 9,274 Mc/s and 23,914 Mc./s both at room temperature and at liquid nitrogen temperature. The value of *g* obtained by them are as under.

	Room temp	*Liquid nitrogen temp*
g	$2·14 \pm 0·075$	$2·07 \pm 0·08$

TABLE OF PARTIALLY KNOWN & UNKNOWN COMPOUNDS WHOSE MAGNETIC MOMENT DETERMINATIONS CAN BE UNDERTAKEN

NAME OF ISOTOPE	ISOTOPE %	SPIN	MAGNETIC MOMENT	SOLUBLE COMPOUNDS
${}_{12}Mg^{25}$	11 5		Not known	$MgCl_2$, $6H_2O$, $Mg(Cr(SO_4)_2)_2$ $12H_2O$, $MgBr_2$, $6H_2O$
${}_{12}Mg^{26}$	11 1	Zero		
${}_{24}Cr^{53}$	9 43		Not known	$CrBr_3$ $6H_2O$, CrO_3, $Cr_2(SO_4)_3$, $18H_2O$
${}_{25}Mn^{55}$	100	5/2	3 0	$MnBr_2$, $MnCl_2$, $Mn(No_3)_2$
${}_{27}Co^{59}$	100	7/2	2 7	Chlorate, chloride, nitrate
${}_{33}As^{75}$	100	3/2	1 5	Pentaoxide, arsenic acid
${}_{38}Sr^{87}$	7 00	9/2	—1 1	Iodide (hydrate), chlorate, permanganate chloride, nitrate
${}_{47}Ag^{107}$	51 9	1/2	—0 10	Perchlorate, fluoride, nitrate
${}_{47}Ag^{109}$	48 1	1/2	—0 19	
${}_{49}In^{113}$	4 5	1/2	5 52	InF_3, $3H_2O$ X X
${}_{49}In^{115}$	95 5	9/2	5 52	
${}_{53}I^{127}$	100	5/2	2 812(3)	Some of the iodides given above
${}_{56}Ba^{135}$	6 59 1 32	3/2 3/2	0 837 0 935	Acetate perchlorate iodide
${}_{79}Au^{197}$	100	3/2	0 195	$AuCl_3$ only
${}_{82}Pb^{207}$	22 64	1/2	0 6	Acetate, perchlorate, nitrate

The theoretical value of *g* is 2·00 if the magnetic field is entirely due to electron spin

It is clear from this brief review that there is a very good scope for studying the closely spaced energy levels in the case of paramagnetic substances by microwave spectroscopy Also for the ferromagnetic crystals very useful data can be obtained for studying their structure and microwave spectroscopy in this field offers great possibilities

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Desilverization of Lead Bullion — Literature Report No. 13

P I A NARAYANAN & M C SEN

National Metallurgical Laboratory, Jamshedpur

LEAD smelting in India from indigenous lead ore was started on a small scale in 1944 by the *Metal Corporation of India Ltd* with its smelter located at Tundoo, about 11 miles from Dhanbad Their mines are situated at Zawar, 25 miles from Udaipur The lead sulphide concentrates, as delivered to the smelter, contains about 10 oz of silver to the ton and lead bullion produced assays between 20 and 26 oz silver per ton (0 06122 per cent and 0 07960 per cent) After refining to remove impurities like iron, copper, etc, the lead ingots, containing most of the silver in the ore, are marketed Silver is not separated at present from the lead and it is finding its way to the market with the commercial lead This is not only a national loss, but a silver content over 0 002 per cent is considered as an objectionable impurity in the lead which, obviously, restricts the use of this lead to a very great extent Production of lead in 1948 amounted to only 562 tons, but with the starting of their ore-dressing plant, the output is expected to increase considerably and the silver problem will assume greater importance

The problem of desilverization of lead bullion was submitted for investigation to the National Metallurgical Laboratory by the *Metal Corporation of India Ltd* This report attempts to give all information on the subject available from current literature i e the various processes adopted in other countries their limitations etc

Smelting Process

Lead occurs in nature in various forms but the most common is the sulphide galena This mineral is very often associated with zinc sulphide (sphalerite) Varying amounts of silver and gold are also present which make a valuable byproduct and these precious metals consequently allow a poorer grade of lead ore to be mined than the same grade of straight lead ore

The various smelting methods for lead ore are outlined below

Roast Reduction or Blast Furnace Method — The sulphide ore is first crushed to suitable size and mixed with iron ore and limestone and charged into cast iron sinter ports After lighting a stream of air is drawn through the charge The sulphur of the ore is burnt to sulphur dioxide and the whole mass is oxidized and gets agglomerated The resulting porous mass called sinter is charged into the blast furnace with requisite amount of coke which reduces the oxides of lead into metal The gangue material in the ore combines with the flux to form a fusible slag a calcium iron silicate The slag is tapped through the slag notch while the metal is syphoned out and cast into bars

Roast Reaction Method — This is carried out in a reverberatory furnace Rich sulphide ore is first heated in an oxidizing atmosphere when a part of sulphur is burnt away It is then heated strongly in a reducing atmosphere when the oxidized portion of the ore reacts with the sulphide with the production of metallic lead

Precipitation Method — Galena and scrap iron are charged into a blast furnace along with the requisite amount of coke as fuel The sulphur of the galena combines with the iron to form a matte and metallic lead is set free Some of the sulphide is also converted into oxide and sulphate which react with the sulphide to form sulphur dioxide and metallic lead Oxidized ore also is charged sometimes in the blast furnace

Impurities Generally Present in ' Base Bullion "[1]

The impure lead (base bullion) produced from blast furnace or other smelting operations contains a large number of impurities which have to be removed before marketing The impurities are derived from the gangue present in the ore and from various raw materials used during the smelting process i e iron ore limestone scrap iron coke Some iron also finds its way into the lead from the cast iron kettles during refining and desilverization The common impurities present are copper iron zinc silver gold antimony bismuth tin cadmium nickel cobalt tellurium and selenium

Maximum Permissible Impurities in Refined Lead[1]

The maximum impurities permitted in refined lead are given below as specified by the American Society for Testing Materials (A S T M Designation B29 40)

Effects of Alloying Elements[1]

The effects of various alloying elements on the properties of lead are (1) addition of alkali and alkaline earth metals in very small

	%	Corroding lead	Chemical lead	Acid lead	Cu lead	Common desilverized lead A	Common desilverized lead B	Soft tin desilverized lead
Silver	Max	0 0015	0 020	002	002	002	002	002
	Min		0 002					
Copper	Max	0 0015	0 080	080	080	0025	0025	040
	Min		0 040	040	040			
Silver and Cu together	Max	0 0025						
Arsenic	Max	0 0015						
Antimony and tin together	Max	0 0095						
Arsenic, antimony and tin together	Max		0 002	002	015	015	015	015
Zinc	Max	0 0015	0 001	001	002	002	002	002
Iron	Max	0 002	0 002	002	002	002	002	002
Bismuth	Max	0 05	0 005	025	10	15	25	005
Lead (by difference)	Min	99 94	99 90	99 90	99 85	99 85	99 73	99 93

quantities results in superior qualities to lead base bearing metals but resistance to corrosion is decreased (2) aluminium when added even in small quantity (0 5 per cent) the lead has got less tendency to attack the iron of the kettle and to oxidize (3) antimony when added even up to 0 5 per cent hardens the lead appreciably It is added up to 16 per cent in bearing metals (4) bismuth along with tin forms a series of very fusible alloys (5) cadmium up to 0 25 per cent increases the strength (6) calcium in amounts from 0 0025 per cent to 0 1 per cent makes lead suitable for cold working and improves some properties such as creep resistance (7) magnesium effects some age hardening but is detrimental to corrosion resisting property Precipitation of magnesium phase also causes lead alloys to disintegrate and (8) nickel and sulphur reduce the tendency of segregation in some alloys of lead

Refined Lead Produced by the Metal Corporation of India Ltd

The refined lead produced by the *Metal Corporation of India Ltd* analyses as follows

Bismuth	0018 to 0024%
Antimony	0160 to 0235%
Iron	0029 to 0030%
Nickel	0032 to 0045%
Copper	0098 to 0107%
Silver	20 to 26 oz per ton (06122 to 07960%)

Lead is marketed at present by the *Metal Corporation of India Ltd* without being desilverized A ton of the lead contains on an average 23 oz of silver which at the present market rate will fetch over Rs 100 As a silver content over 0 002 per cent (0 72 oz / ton) is not allowed by many of the lead consumers this impurity has to be separated from the lead The loss now being incurred in this respect will assume serious proportions when production is stepped up in the near future

Desilverization Methods[1 4]

The following are the standard methods of desilverization of lead

1 *Cupellation Process* — If an alloy of lead and silver is melted and exposed to a blast of air the lead oxidizes and is removed as litharge The silver and gold which have no affinity for oxygen are left behind

2 *Pattinson Process* — The principle of the Pattinson process lies in the fractional crystallization of pure lead when molten lead containing silver is allowed to cool The lead containing 0 009 per cent of silver or more is cooled until a certain proportion for instance seven eighths of the total lead has crystallized the crystals are removed by means of a perforated ladle The portion remaining liquid is then nearer to the eutectic composition than the original alloy and is hence richer in silver The crystals which separate consist of pure lead Since a portion of the separated lead always retains mechanically a small portion of the silver rich alloy it is necessary to remelt the crystals and repeat the above process

The liquid portion is transferred to another pot and the process of crystallization is repeated until the final products are almost pure lead containing not more than 0 0001 per cent of silver and an alloy of the eutectic composition Since this alloy solidifies at constant temperature it is evident that the process of fractional crystallization cannot be carried out any further

3 *Parkes Process* — This method of separating silver from lead by the use of zinc depends on (1) a greater affinity of gold and silver for zinc than for lead and (2) the insolubility of zinc silver alloys in lead which is saturated with zinc The process consists in brief of stirring 1 to 2 per cent of zinc into a bath of molten lead heated to above the melting point of zinc (419°C) and allowing the mixture to cool whereupon a crust rises to the surface of molten lead containing nearly all the silver and gold This crust containing most of the silver and gold is removed by means of perforated ladles A repetition of zinc addition in smaller quantity after reheating gives again a crust but of lower silver content and leaves a molten lead that is practically free from silver containing usually not more than 0 20 oz of silver and gold per ton

The zinc crust (2 000 to 15 000 oz of silver/ton) which contains considerable lead besides the zinc and precious metals is distilled in retorts for the recovery of zinc and to obtain an enriched retort bullion which is cupelled to produce an alloy of silver and gold with litharge as a byproduct

4 *Betts Electrolytic Process* — Base bullion is cast into anodes and refined lead gets deposited in the cathode The cathode

consists of cast refined lead sheets of $1\frac{1}{16}$ in thickness. The electrolyte is a solution of lead fluosilicate, the composition of which varies considerably, representative values being 80 gm /litre each of lead and free H_2SiF_6, corresponding to a total SiF_6 content of 135 gm./litre Voltage used is approximately 0 45 with a current density of 15 to 18 amp /sq ft. The temperature should be between 30° and 40°C The precious metals along with other metallic impurities are thrown down as anode slime from which the precious and other metals are recovered

Comparative Merits & Demerits of the Processes

1 *Cupellation Process* — This process is applicable to lead very rich in silver It has become obsolete as an independent process for desilverization due to heavy metal losses , labour and operating costs are also very high It follows Parkes or Pattinson processes for refining the gold and silver

2. *Pattinson Process* — The lead cannot be enriched more than 500 to 600 oz of silver per ton as a result of which a considerable quantity of lead has to be handled for cupellation resulting in much metal loss and higher labour and operating cost The process is elaborate as it requires repeated recrystallization, large number of operating kettles, sometimes up to 15, and as many as 11 recrystallizations The silver content of the resulting desilverized lead (0 3 to 0 5 oz /ton) is higher than that obtained by Parkes process (0 2 oz /ton or less)

3 *Parkes Process* — The alloy obtained is very rich in silver, 2,000 to 15,000 oz /ton The operating cost is low The zinc can be used again and again with very little loss It requires less operations, perhaps two additions of zinc, sometimes even one is sufficient to complete the process and only one or two kettles will be required It produces commercial lead very low in silver, 0 1 to 0 2 oz per ton. Smaller amounts of gold and silver can be recovered by this process and loss of both silver and lead is much lower This process requires purer bullion as the impurities present consume zinc Furnace lead containing 4 5 per cent of metallic impurities will consume 2 87 per cent of zinc whereas softened lead will require 1 75 per cent of zinc. The residual zinc in the desilverized lead has to be removed by a refining operation

(4) *Betts Electrolytic Process* — It produces lead of exceptional purity and at the same time recovers all the metallic impurities contained in the bullion It is most suited where bismuth content is high or where the total impurity is very high It is also suitable where the fuel cost is high in comparison with the rates for electric power

Conclusion

Of all the desilverization methods, Parkes process appears to be the simplest But, before the addition of zinc, the furnace lead has to be thoroughly softened by removal of impurities like iron, copper, antimony, etc As regards the quantity of zinc to be added in the first and second stages, there are differences of opinion[8] The most suitable additions have to be determined by actual experiments A modification of the Parkes process uses an alloy of zinc and aluminium (0 5 per cent)[5-7] which recovers all the silver in one operation The separation from lead of the zinc-silver crust is better when the zinc-aluminium alloy is used

Acknowledgement

The authors wish to express their thanks to the Director, National Metallurgical Laboratory, for the permission to publish this report.

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REVIEWS

Earth Current Results at Tucson Magnetic Observatory (1932-1942) by W J Rooney Researches of the Department of Terrestrial Magnetism Carnegie Institution of Washington Publication 175 1949

THE EXISTENCE OF EARTH CURRENTS (i e induced currents quite distinct from any artificial currents) was first postulated by Davy in 1821 but the proof of their existence was obtained only after the discovery of electromagnetic induction In 1847 Barlow adduced evidence of earth current flow from measurements on telegraph lines in England and when the existence of earth currents was shown to be universal rather than a local phenomenon extensive investigations were undertaken on this subject

Systematic and continuous observations of earth currents have been carried out at a number of European stations viz Greenwich Berlin and Paris and several valuable observations have been made The study of earth currents was revived at Ebro (Spain) in 1910 and the Ebro records covering the period 1910 1938 are the most valuable and extensive records yet made More recently installations for continuous recording on duplicate lines has been made at Watheroo (Western Australia) and at Huancayo (Peru) The use of duplicate lines provides independent records and serves as a check on the operation of measuring systems Both these stations were operated by the Carnegie Institution of Washington In March 1931 continuous registration of earth current potentials was undertaken at the Tucson Magnetic Observatory as a co operative project of the U S Coast and Geodetic Survey the Bell Telephone Co and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington The period of operation (1932 1942) a little over eleven years covered a full and typical sunspot cycle a fact which has enhanced the value of the records for purposes of correlation with allied phenomena The observations and findings of the Observatory are given in this report

Measurements & Apparatus — Direct measurement of earth currents is not possible Information on their magnitudes direction and other characteristics must be inferred from measurements of potential combined with records or estimates of resistances to their paths of flow Potential measurements are generally made by the use of galvanometers which have two pairs of pointers lying on lines of different azimuths and which determine the magnitude and direction of the potential gradient Registration of earth current potentials at Tucson was made on two lines one from Tucson to Mammoth a little under 60 km distant and a little to the east of north of Tucson and the other from Tucson to Wilco which is a little over 90 km away in a nearly easterly direction

The measuring instrument employed at the Tucson Magnetic Observatory consists of two Leeds and Northrup portable lamp and scale galvanometers with a single filament lamp and drum recorder The galvanometer elements carried spherical mirrors with a focal length of one meter The only optical instrument in addition to the spherical mirrors was a single cylindrical lens behind the recorder slit to bring the light beam to a spot focus on the recording paper The current sensitivity of the galvanometer was about $2\ 5 \times 10^{9}$ amp per mm deflection on the drum which was higher than required in view of the long lines used This permitted the use of higher resistance (1 5 megohms) in series with the galvanometer so that the total resistance of the measuring circuit was not appreciably affected by minor variations in line resistances or in contact resistances at the electrodes

Connection between the recording apparatus and the electrodes was made over telephone lines The lines were all of overhead open wire type The electrodes used were web shaped grids of lead wire The common electrode located on the ground of the Tucson Observatory was built up of five concentric circular loops of wire with eight radial arms connecting the loops and meet ing at the centre of the grid to form a core to which the connection to the line was made.

Discussion — The absolute values of potentials recorded on any earthed line include the potential differences due to earth current flow and the potential difference which depends on the electrochemical activity at the electrodes, but these do not indicate any current flow On short lines, the electrochemical potentials are usually predominant and may be hundred times as great as those due to earth current flow Since these electrode potentials are independent of the distance between the electrodes, their significance decreases as the length of the line is increased The daily mean values at Tucson, which represent chiefly electrode potential and changes in them from day to day, indicate mostly slow variations, usually only a few per cent of the maximum and minimum values recorded during any day Too much significance should not be attached to the mean daily values but the differences between individual values and the means for periods over a month or longer are important For this reason studies were restricted largely to the analysis of variations in recorded potentials While the basic data are usually compiled in a large number of tables in the form of mean values for each hour and each day, the discussion is confined mainly to variations of monthly and yearly mean values

Solar Diurnal Variation — The variation easily amenable to analysis and statistical treatment is the solar diurnal variation From the voluminous data presented in this volume, it is found that a definite and consistent difference exists between the diurnal variations recorded on calm days and those on disturbed days, but in general the differences are small

The station at Tucson is a middle latitude station The chief features of such a station are a large flow of current towards the equator, one in the forenoon and the other in the afternoon, and a definite double rotation of the current, which is large during daylight hours and small at night

Relation to Solar Activity — Variations both in frequency and intensity of disturbances, corresponding to variations in solar activity, have been observed in all the records of earth current flow There is also a relationship between normal earth current activity and solar activity which is quite distinct from the disturbance effects

There is close correlation between sunspot numbers and the range of diurnal variation in earth currents

Seasonal Changes — The seasonal changes are chiefly changes in intensity, accompanied by minor shifts in phase relationship between the two components of current Such changes are described quantitatively The Tucson Observatory, however, is located in the so-called " transition belt " where the diurnal variations of the magnetic elements pass from higher latitudes to the equatorial level and the circulatory current systems in the ionized layers of the upper atmosphere are alternately north (summer) and south (winter) of the station For this reason, the seasonal changes in earth current flow are much more complex and cannot be readily evaluated

Lunar Diurnal Variation — Lunar diurnal variation is important because of its bearing on the critical appraisal of several theories advanced to account for the magnetic variations and earth current flow Preliminary evaluation of the data relating to lunar diurnal variation at Tucson has been carried out by the method of Chapman and Egedal The records used were those for a single year (1932) and a definite lunar diurnal variation with a markedly double period was found Its magnitude is about one-fifth of the solar diurnal variation Because of the large and complex seasonal changes at Tucson, it was found that a single year's record was not sufficient to demonstrate accurately the changes in lunar variations with the phase of the moon

AJIT GUIN

The Properties of Metallic Materials at Low Temperatures, Vol I, by P Litherland Teed (Chapman & Hall Ltd , London), 1950, pp viii + 222 Price 21*s* net

THIS IS THE FIRST OF A SERIES OF MONOgraphs on " Metallic Materials " published under the authority of the Royal Aeronautical Society The author has made a special study of the literature relating to the influence of low temperatures on the mechanical properties of metals and attempted in this book to write a critical appreciation of the present state of knowledge of this increasingly important subject.

The influence of low temperatures on metallic materials had been recognized in early times but in modern times mechanical refrigeration and the ever-increasing number of its industrial applications has necessitated knowledge of the physical consequences of low temperatures in relation to engineering materials. Flying in stratosphere is now making a similar and more exacting demand. The author points out the inadequacy of the present-day knowledge on the subject but feels that "it is still possible to draw certain conclusions, some reassuring and some creating a certain feeling of apprehension" from the existing knowledge.

The author has compiled and reviewed the experimental results of various research workers on the influence of low temperatures on the main mechanical properties — limit of proportionality, yield stress and ultimate stress in tension and compression, yield stress and ultimate stress in shear, yield stress in bearing, elongation and reduction of area, notched-bar impact strength and notch sensitivity under static loading, Young's modulus — shear modulus, bulk modulus and Poisson's ratio. The experimental results available are not very complete. Admittedly, it is not yet possible to predict either on the basis of extrapolation or of calculation, the mechanical properties of a metallic material at one temperature from an experimentally derived knowledge of these at another. Accordingly, only brief references to such theories have been made in the text.

In this review similar alloys have been grouped in each chapter. Mainly a few ferrous alloys (austenitic stainless and other ferritic alloys), aircraft aluminium alloys, a few magnesium and copper alloys and nickel, tin and lead have been included in the survey.

The book is an excellent critical survey of the existing published literature on the subject and would be of great assistance to research workers in the field as well as to engineers and designers as a reference book. Considering the very specialized nature of the book the price of 21*s* is not excessive.

M S Mitra

Principle of Aerodynamics, by James H. Dwinnell (McGraw-Hill Book Co Inc., New York), 1949, pp xi + 533. Price $4.00

In recent years, many new books on aerodynamics are coming out, both for classroom study and professional use. Every book has some distinctive feature about it, depending upon the author, where he is attached to — a teaching institution, or research and development laboratory or industry.

The book under review is distinctively a new text, giving an up-to-date introduction to the theoretical and practical aspects of aerodynamics. The scope of the principles outlined in the book is no doubt absolutely essential for a basic text-book on aerodynamics. This can be attributed to the fact that the modern high-speed heavy bombers, rockets and jet planes have radically changed the pre-war conception of the aerodynamic design of aircraft. Today, an aeronautical engineer is called upon to deal with the design of supersonic aircraft, fitted with jet engines. In this respect this book presents entirely new materials for a student who is on the threshold of his career as an aerodynamic engineer.

The author has also endeavoured to bring home the many problems that are being confronted with by engineers engaged in the development of modern aircraft. There are fifteen chapters and some of them are complete in themselves. So much so, the student can easily omit a few advanced topics on his first reading and then go back to them for completion. Detailed discussions on some advanced topics like fluid dynamics, airfoils, viscosity, compressibility, power plants and performances, etc., are given in some chapters. The outstanding features of the volume are the large number of photographs of exceptional quality, a bibliography and two appendices giving a vast amount of experimental data useful for the purpose of comparison with the theory outlined in it.

The author has, however, skipped one important topic, namely the discussion on spanwise airload distribution. In many cases he has set for students as problems the so-called simple proofs of fundamental principles, which only go to show to a remarkable degree the originality exhibited by the author.

The reviewer feels that this book will serve as a text-book for many years to come.

V. Cadambe

The Chemistry and Metallurgy of Miscellaneous Materials: Thermodynamics, National Nuclear Energy Series, IV, 19B, Edited by Laurence L Quill (McGraw-Hill Book Co. Inc, New York), 1950, pp. 329 Price $ 3 00

THE WORK ENTITLED " THE CHEMISTRY AND Metallurgy of Miscellaneous Materials Thermodynamics " will be of special interest to chemists and metallurgists The book is a collection of papers dealing with the reports and summary articles of the plutonium project on chemistry and metallurgy of miscellaneous materials including thermodynamical aspects of the plutonium project

The volume consists of ten papers dealing with the reports and summary articles contributed by various authors The first paper mainly concerns itself with temperature-composition diagrams of the liquid-solid phase equilibria between the 6 salt pairs obtained from the bromides and iodides of strontium and barium These diagrams are presented in the light of data obtained in the investigation of low-melting high-molecular weight salt baths The second paper which deals with " Temperature-composition Diagrams of Metal-metal Halide Systems " explains all the phase diagrams of different systems by thermal analysis

The third paper which describes " The Thermodynamic and Physical Properties of the Elements " gives tables of heat contents, vapour pressures, heats of vaporization and entropies of vaporization for more than 60 elements The fourth paper which deals with " Thermodynamic and Physical Properties of Nitrides, Carbides, Sulphides, Silicides and Phosphides " describes and discusses the tables of free energies, heats and entropies of formation at 298°K for many nitrides, carbides and sulphides A table of stable gaseous compounds is presented for the 3 temperatures, 1,500°, 2,000° and 2,500°K, for the pressure range 10^{-8} to 10^{-5} mm Hg to help in interpreting high-temperature reactions in vacuum systems This paper also includes a second table of all possible refractory nitrides, carbides and sulphides for the same temperature and pressure ranges as those given for stable gaseous species. This paper further discusses briefly the application of the refractories in the construction of high-temperature high-vacuum systems The fifth paper, which deals with " The Thermodynamic Properties of Common Gases ", gives tables of free energy, entropy and other thermodynamical data for common gases of importance in high-temperature reactions It also gives references to tables of thermodynamic functions of many of the less common gases The sixth paper which deals with " The Thermodynamic Properties of the Halides " includes 5 valuable tables of the thermodynamical properties of the liquid and solid halides of all the elements It includes also 5 appendices of which the first shows the relations between the various thermodynamic properties of elements, compounds and solutions, the second shows the use of lattice energies in estimating and checking heats of formation of compounds, the third explains the use of heats of solution in estimating and checking heats of formation of compounds, the fourth illustrates the use of the tables for various thermodynamical calculations and the last indicates the order of arrangement of the chemical elements in the tables The seventh paper of the work, which deals with "The Fusion and Vaporization Data of the Halides ", gives tables of melting points, heats of fusion, heats of vaporization, boiling points and vapour pressures of the halides with discussion of the factors affecting volatility The eighth paper, which deals with " The Thermodynamic Properties of Molybdenum and Tungsten Halides and the Use of These Metals as Refractories ", presents a brief summary of the high-temperature chemistry of the metals molybdenum and tungsten halides, laying stress on the suitability of the metals as refractories This paper indicates conditions for non-attack of the metals by halogens, hydrogen halides and other halogen compounds It also presents the methods of preparation of the halides and their high-temperature properties The ninth paper which deals with " The Heats of Formation of CeS, Ce_3S_4 and Ce_2S_3 at 25°C " concerns itself with the measurement of heats of solution of these materials at 25°C Using rhombic sulphur as the standard state, heats of formation are calculated and the results are interpreted and correlated with other experimental data The final paper of this work which deals with " The Heat of Reaction of the Cerous-ceric Couple in 0 5 Molal Perchloric Acid at 25°C " describes calorimetric determination of the heat of reaction of the cerous-ceric couple in 0 5 molal perchloric acid by estimation of heat of the reaction of ceric ion with hydrogen peroxide Oxalic acid and hydrogen peroxide were used as thermochemical standards Results of using the former were unsatisfactory while those which were obtained by using hydrogen peroxide indirectly were found to be satisfactory

This work presents a very wide range of data which is found scattered in various records and summaries of the plutonium project The subject-matter is authentic and reliable and is useful to the students and research workers in the fields of metallurgy, crystal chemistry, refractories, rare earths, etc This volume should prove a very valuable reference literature on these subjects

A K CHATTERJI

Electrical Engineering Economics, Vol I, by D J Bolton (Chapman & Hall Ltd, London), 1950, Third Edition, pp xi + 292 Price 25*s* net

THE AIM OF THE AUTHOR IS TO GIVE TO practising engineers and students a good account of elementary economics that concerns the electrical engineers and its application to practical problems Volume I, now under review, is divided into two parts

Part I deals with general principles, standard definitions and explanations of economic problems and engineering formulae The principles of productivity and other engineering aspects are made intelligible and useful to engineers

Part II deals with the general problem of economic choice of electrical plant The various problems and variable factors have been stated and methods suggested to work out a complete theory and practice of economic choice

This volume is intended to enable engineers and others interested in power development schemes to assess the cost of the electrical service and compare alternatives This will help in setting up criteria for the design and choice of engineering plant

Chapters I to III deal with the principles of the capital investment, sinking fund total and annual depreciation Chapters IV and V deal with the transfer of the undertakings and productivity The economics of this is explained by formulae and suitable examples

Chapters VI to XII deal with the methods of arriving at the proper size and capacity of the plant, principles involved in assessing the utility and life of the various types of equipment such as transformers, motors, power cables and lamps by taking into consideration their efficiency and special design characteristics and their cost

The economics of overloading for prescribed periods admissible by the engineering standards are also discussed A very useful set of appendices supplement the details given in the book

This book will be a valuable asset for power engineers connected with the design of large undertakings involving big capital The economic principles explained in the book can be conveniently applied to items in different countries

B K R. PRASAD

Industrial Microbiology, by Samuel Prescott & Cecil Gordon Dunn (McGraw-Hill Book Co Inc, New York), Second Edition, 1949, xii + 923 Price $ 8 50

THE FIRST EDITION (1940) OF THIS PUBLICation has been so popular amongst scholars, research workers and technologists engaged in the field of microbiology that a revised edition, bringing up to date the information on the subject, has really been quite welcome The rapid developments in the field of fermentation technology and the extension of its scope in industrial production, both in technique and variety during the past decade, have necessitated the rewriting of some chapters of the first edition and the addition of five new chapters on saccharification, yeast production and yeast products, 2, 3-butanediol, itaconic and related fermentations, and antibiotics The chapters on yeast have been combined into a single chapter in this edition and expanded by incorporating much new material on food and fodder yeasts, riboflavin production and discussion of methods of industrial operation These aspects have a special reference to industrial applications and possible future developments

The authors have done justice to the subject and, in its revised form, the book is useful both to the research worker and the technologist The former will find a mine of information for further research and the exhaustive bibliography, provided at the end of each chapter, is a valuable research aid The technologist will find in the book a valuable guide which he can consult for information on the practical problems of processes and techniques. It may be observed, however, that in the attempt to cover a vast and rapidly developing field within the compass of a single volume, the treatment of the different aspects of industrial microbiology has become somewhat uneven For instance, the discussion on textile microbiology — particularly on the important aspect of retting — is not as exhaustive as one would have wished The book is well got-up and it is refreshingly free from printing errors

S A C

Electronic Valve : Book I — Fundamentals of Radio-Valve Technique, by J Deketh (Philips Electrical Co (India) Ltd, Calcutta), 1949, pp 022 + 535 Price Rs 24

The well-known radio manufacturing firm of Holland, Philips, have undertaken the publication of a series of books on electronic valves of which the present volume forms book I, thus making obvious the choice of its title and scope It is intended primarily " to give engineers and technicians not specialized in radio and allied techniques an impression of the construction and functioning of radio valves and their applications in receiving sets and other electronic apparatus " Notwithstanding its chief appeal to the practical men, university graduates and research workers specialized in radio and communication engineering and accustomed to study theoretical treatises will do well to read this book for useful practical hints that may prove beneficial in the design and construction of special apparatus The book gives explanations of various phenomena associated with an electronic valve and the physical principles underlying them without giving elaborate mathematical details and yet not creating the impression of having avoided mathematical treatment wherever felt necessary.

First five of its thirty-three chapters deal with physical concepts and basic principles of electronic emission, electron ballistics and secondary emission Chapters VI, VII and VIII are devoted to construction and manufacture of valves of various types Illustrations are given of the machinery used at various stages of construction and of the test gear. Information of this kind is not available in other books Chapters IX to XXVII deal with the linear and non-linear characteristics of a valve and the usual circuits based upon them such as amplifiers, oscillators, rectifiers, etc. Frequency conversion, negative feedback and AVC find a chapter each as also tuning indicators and AGC Effects of hum due to mains voltage and microphones are discussed in chapters XXVIII and XXIX respectively. The last three chapters are devoted to ageing effects and power supply considerations

There are nine appendices covering such topics as units, D C and A C, and oscillating circuits, as also useful tables and graphs The book ends with a list of relevant Philips publications on the subject and a reference list of books for further studies

The style is simple and direct with some continental influence on the language at places It deserves a place on the book-shelf of every one interested in the practical side of electronics

N B Bhatt

Publications Received

Introduction to the Transfer of Heat & Mass, by E R G Eckert, McGraw-Hill Book Co Inc, $ 4 00

Testing Radio Sets (Fifth & Revised Edition), by J H Reyner, Chapman & Hall Ltd, *22s 6d*

An Introduction to Electronics, by J Yarwood, Chapman & Hall Ltd, *28s*

Indian Sugar Statistics, Ministry of Agriculture, Rs 1/4 or *2s*

Hydrology (The Fundamental Basis of Hydraulic Engineering) (Second Edition), by Daniel W Mead, McGraw-Hill Book Co Inc

General Chemistry (Second Edition), by Timm, McGraw-Hill Book Co Inc, $ 4 50

Physico-chemical Constants of Pure Organic Compounds, by J Timmermans, Cleaver-Hume Press Ltd, *95s*

Piezoelectric Crystals & Their Applications to Ultrasonics, by Warren P. Mason, Macmillan & Co Ltd, *56s*

Soils — Their Physics & Chemistry, by A N. Puri, Asia Publishing House, Bombay, $ 7 00

The Properties of Asphaltic Bitumen, by J P J Pfeiffer, Cleaver-Hume Press Ltd, $ 6 00

Atomic Physics, by Wolfgang Finkelnburg, McGraw-Hill Book Co Inc., $ 6.50

Medicinal & Industrial Aspects of Fungi

UNDER the joint auspices of the Society of Fermentation Technologists and the Society of Pharmacology & Experimental Medicine India a symposium on the Medicinal and Industrial Aspects of Fungi was held during August 1950 at the Indian Institute of Science Bangalore Seven papers reviewing recent developments in the following fields were presented (1) pathogenic fungi (2) fungi and immunological changes (3) culture and maintenance (4) nutrition and metabolism of fungi and (5 industrial aspects dealing with production of acids antibiotics and enzymes by fungi

The pathogenic fungi form a heterogeneous group consisting of actinomycetes certain molds and mold like fungi and a number of yeasts and yeast like organisms for which it was pointed out no satisfactory system of classification exists Two major groups those causing (1) superficial mycosis and (2) deep seated mycosis were considered with particular reference to the more common fungus infections namely Aspergillosis Dermatophytoses Maduromycoses and Sporotrichosis

The use of fungal infections as a means of investigating immunological phenomena was the subject matter of another paper Considering the fact that the tubercle and diphtheria bacilli are more closely related to the fungi than are the true bacteria these forms it was held could be regarded as connecting links between the bacteria and fungi proper some of which are pathogenic for man and lower animals Fungal infections should be considered in the differential diagnosis of many obscure infections It was pointed out that many immunological phenomena have been demonstrated with experimental fungal infections and the close analogy of fungal infections to diseases like tuberculosis and leprosy was cited as examples

Culturing and maintenance of fungi with reference to their biochemical performance (production of acids antibiotics and enzymes) was stressed as a major problem and should claim the attention of microbiologists dealing with fungi of industrial importance The advantages and simplicity of the method of studying the biochemical activity of fungi on solid media by incorporating test substances like starch neutralizing agents or bacteria during growth were discussed

The general tendency of fungi towards spontaneous change under different cultural conditions was pointed out as an important problem for investigation and the necessity for efficient methods of maintaining organisms to give reproducible performances was stressed

The nutritional and metabolic performance of fungi were dealt with in another interesting paper The peculiarities of mold fermentation and the influence of environmental conditions on these were discussed The adoption of more modern and efficient techniques of submerged fermentation was stressed Improvements in metabolic performance in industry of organisms employed by judicious selection of strains and induced mutation was emphasized

The industrial production of organic acids by fungi using cheap carbohydrate substrates was discussed in another paper The production of citric acid using *Aspergillus niger* by the surface and submerged fermentation was described stressing the rôle of the trace elements in the process The production of gluconic acid using shallow rotary drums and semi continuous fermentation methods and the conditions under which other acids like kogic and gallic were produced were indicated

Recent research in antibiotics has emphasized the need for drugs complementary or supplementary to penicillin Isolation of potent strains is of utmost importance Irradiation with X rays and ultra violet rays to evolve suitable strains and the influence of substrate composition minerals and trace elements nitrogen source and added nutrients on the production of penicillin were presented in a paper entitled Production of Antibiotics The production and purification of amylases were discussed in a paper Production of Enzymes from Molds Methods of continuous fermentation employing submerged fermentation their advantages over conventional methods were described Factors affecting the production of diastase by *Aspergillus oryzae* with particular reference to trace element nutrition and the influence of the sources of carbon and nitrogen in the substrate were described The use of antiseptics for the control of bacterial contamination in industrial practice and the action of specific antiseptics on the sporulation and amylase production were described

T N R Rao

NOTES & NEWS

Atomic Standards

The U S National Bureau of Standards is considering the possibility of replacing the present standards of time, length and mass by a complete set of primary standards which would remove the need for making corrections necessitated by irregularities in the motion of the earth and for maintaining arbitrary standards (*Nature*, 1950, 166, 167)

The establishment of primary standards based on atomic properties could be carried out along the lines adopted for establishing the standard of length in terms of the wavelength of a selected spectral line Preliminary measurements reported by the U S National Bureau of Standards, the National Physical Laboratory and the International Bureau of Weights and Measures permit present definition of the metre as 1,831,249 2 wavelengths of the green radiation characteristic of mercury 198 in standard air To make this independent of possible variations in air density, the atomic metre could eventually be defined as a number of waves *in vacuo* Similarly the unit of time — the standard second — could be defined as the duration of a certain number of oscillations of an electromagnetic field the frequency of which lies at the centre of some well-defined microwave absorption line The ammonia molecule has already been used for this purpose in the atomic clock Its spectral absorption band has the constancy of the mid-frequency like the spectral lines in optical spectroscopy This is further improved due to the high Q of the ammonia gas which is about 1,00,000 at N T P The mass unit could be based upon the absolute measurement of gyromagnetic ratio of the proton, making use of these definitions of length and time For example, unit field strength of magnetic induction can be defined as that field in which protons would precess at the rate of 4257·84 cycles per second Similarly the unit of current and force can be defined A set of working definitions is given as under *Atomic Metre* — The length equal to 18,31,249 2 wavelengths from the '5,460 7532 A" line of mercury 198 in standard air *Atomic Second* — The time required for 2 38,701 × 10^5 oscillations of the 23,870 Mc or 3,3 line of NH_3 *Atomic Ampere* — The current flowing in an infinite solenoid of 1,000 turns per atomic metre which gives proton nuclear resonance at a frequency of 53,505 6 cycles per atomic second in a sample located at the centre of the solenoid *Atomic Newton* — 5 million times the force exerted on each atomic metre length of either of the two infinite parallel wires separated by one atomic metre and carrying one atomic ampere *Atomic Coulomb* —charge transported by one atomic ampere in one atomic second, and *Atomic kilogram* — The mass which experiences an acceleration of one atomic metre per atomic second squared, when acted upon by a force of one atomic Newton

Permanent Magnet Electron Microscope

A new type of console electron microscope in which the cumbersome electromagnetic devices used in earlier models have been replaced by permanent magnets has been designed at the *Radio Corporation of America*

The new model has magnets in bucking arrangement or in configurations, disposed either radially or parallel to the optical axis of the lens The intricate coil systems of the electromagnet and the specially stabilized electronic circuits with batteries for providing constant voltage to the lenses employed in the earlier models have been eliminated in the new design by using about 4 lb of magnetic steel This arrangement has made the microscope very much simpler in alignment and more stable in operation A constant resolution on all accelerating voltages can be obtained, a factor useful in the calibration and standardization of electromicrographs Focussing in earlier models is done by slowly varying the current feeding the objective lens whereas in the new model the accelerating voltage can be varied (through a known range) to get sharp electromicrographs since the lenses are of permanent type The model has, however, limited applications as its magnification range is between 1500 X and 6000 X and the resolution is not better than 100 Aµ The instrument would be useful in industry for the solution of a variety of problems such as rapid and easy determination of particle size, thickness of films, etc

Synthesis of Ethylenic Compounds

A new method for the synthesis of unsaturated compounds, particularly those containing one or more ethylenic groups adjacent to a carbon atom, has been recently developed (*Chem Age* 1950, 63, 91) Alkyl lithium derivatives are first prepared and these are made to react with the secondary components

Isobutenyl bromide reacts readily with lithium metal in dry ether Carbonization with excess solid CO_2 and isolation of the products yield a mixture of 2 5 dimethylhexa-2 4-diene, β β-dimethylacrylic acid and phorone

The method is a complement to the procedure employing acetylenic precursors and provides a new route for the synthesis of many types of ethylenic compounds which are not easily available

Recent Applications of Lithium

High price of lithium has so far limited its large-scale use in industry Recent improvements in supplies and production techniques have made available lithium and its compounds for use in lubricants, low temperature porcelain enamels and others

Water-soluble lithium derivatives of alizarine and anthraquinone type wool dyes have been produced with lithium carbonate A patent describes the use of lithium carbonate within the range of 0 3 to 3 parts per 100 parts by weight of ground and dried coffee for preserving its flavour and freshness A low temperature dry cell for operation at temperatures down to −60°F has been developed The cell contains LiCl for maintaining the electrolyte in a liquid condition Flash-light dry cells containing such a formulation were operative for 100 min on a closed circuit test at −40°F whereas ordinary dry cells delivered no energy Application of lithium chloride and nitrate to wheat seedlings reduces their susceptibility to powdery mildew and brown rust smaller doses stimulate growth Finely powdered lithium fluoride prevents explosion of mixtures of methane and air The adsorbent property of lithium hydroxide can be made use of in the preparation of gas absorbents by mixing one part of lithium monohydrate with 4 parts of 20 per cent sodium silicate solution and dehydrating The mass is porous and does not become gummy with use

Lithium hypochlorite is a soluble stable solid chlorine bleach and loses only about 2 per cent of available chlorine in 53 days as against 30 per cent lost in 40 days in the case of sodium hypochlorite (*C T J* 1950 **126**, 1421)

Silver-lined Chemical Plant

THE WIDER USE OF SILVER IN THE construction of chemical plant has hitherto been hampered by cost considerations Recent experience has shown that on account of its valuable properties silver can be more economically employed even at current price levels in chemical electrical and food industries with advantage The high initial cost of the plant is largely offset by the recovery value when a plant or vessel is taken out of commission (*Chem Age* 1950 **63**, 196)

The heat transfer characteristics of silver and silver lined chemical plant compare favourably with those of nickel or stainless steel The high thermal conductivity of silver coupled with its freedom from corrosion enables very high overall transmission coefficients to be obtained To overcome its mechanical weakness and liability to sulphur tarnish silver is alloyed with copper and other metals For use under corrosive conditions however 99 99 per cent silver is preferred In the construction of tubes and coils subject to low working pressures massive silver can be used to make up for the tensile strength For service at higher pressures silver tubes and pipes are backed with a stronger metal by drawing down together a pair of heavy walled tubes one of silver and the other of base metal In heat exchangers the silver tubes are expanded to fit tightly in the tube plates which are usually of base metal sheathed with silver on the contact face and through the holes Mild steel vessels can also be given a bended lining if the steel shell is not too heavy Bending is however not possible in thick walled vessels such as high pressure autoclaves the method adopted is to make the lining slightly over sized and press it into place

Uniform coatings of silver as thin as 0 001" or thinner can be applied by electro deposition or metal spraying but are too porous for chemical process work A promising method is the cladding of a silver sheet on a base metal plate before fabrication This would considerably reduce the initial cost of silver lining and extend its range of application

Evaluation of Metal Finishes

THE INSTRUMENTS AND TECHNIQUES which have been developed for the evaluation of surface roughness of metal finishes are described and their possible usefulness to the metal finisher assessed in a paper presented at the recent 37th Annual Convention of the American Electroplaters Society

The microscopic methods such as the Schmaltz light cutting technique and those involving perpendicular or taper sectioning are of limited utility since these are limited by optical factors to give a resolution of about 8 micro inches only It is possible to extend the microscopic methods to give a resolution of one micro inch when they are used in conjunction with interference phenomena The Zeiss interference microscope is useful in the study of surfaces having a roughness range of 2 to 80 microinches The surface can be inspected without special preparation at a magnification of 664 X and can be scanned by moving the specimen with a mechanical stage Proper interpretation of the interference patterns permits the making of measurements in three directions from a single observation Photographic records can be made of areas 0 007" dia The microscope can be used on soft materials exact peak to valley measurements can be made and a better idea of the general texture as well as the exact details of the surface imperfections such as scratches, nodules and pits obtained For matte surfaces and internal measurements electromechanical roughness gauges actuated by a tracer arm equipped with a diamond stylus have been successfully employed over ranges of 0 5 to 3 000 microinches Plastic replicas which are easily and economically prepared can be used with simple optical projectors for the comparison of surfaces against accepted standards down to about 2 microinches Experimental methods for obtaining numerical values of roughness from plastic replicas have been described but commercial instruments for this purpose are not yet available The electron microscope is a potent tool for the study of surfaces but high equipment costs and involved operational techniques limit its general utility

Photo transitor

A NEW TYPE OF ELECTRIC EYE much simpler smaller and sturdier than the present photo electric cell and capable of performing most of the functions of an ordinary vacuum tube is being perfected at the *Bell Telephone Laboratories* (*J Franklin Inst* 1950 **249**, 516) Because of their smaller size and long life the photo transitors should find many applications where it is not practical to use the present photo electric devices

The apparatus consists of a small cylinder of the size of 0 22 calibre rifle cartridge containing a piece of germanium In a small dimple ground into one side of the germanium disc rests the tip of a wire (the collector) At this point the disc is only $\frac{1}{1000}$" thick Light focussed on the opposite undimpled side of the disc can control the flow of current in the wire thus making a control device similar in function to a photo electric cell

The photo transitor has a high power output for a photo electric device in some cases enough to operate a switch directly without preliminary amplification and gives good response to a rapidly fluctuating light source It is sensitive to light given off by ordinary incandescent light bulbs and is well suited to operate with these with good fidelity Another important property of the device is its low impedance

Fractional Weights from Zirconium

IN RECENT YEARS PLATINUM AND aluminium fractional weights are substituted with tantalum and gold ones More recently zirconium has been found to offer some advantages over these metals (*J Franklin Inst* , 1950, **250**, 39)

Zirconium satisfies the rigid specifications for such purposes and is available in sufficient quantities in a high state of purity As the melting point (1 857°-1,860°C) is not high, the metal can be fused easily Its buoyancy correction is +0·041 mg in comparison with −0 070 mg for tantalum and +0 302 mg for aluminium

Four small weights, 50 mg , 20 mg , 20 mg (one dot) and 10 mg , were produced from one sq cm sheet of the metal weighing approximately 0·077 gm They were cleaned with redistilled alcohol, allowed to dry at room temperature (32°C) for two days Σ (100 mg) zirconium was compared with the fiducial weight by the method of substitution taking six observations, the lapse of time between the first and the last being 18 5 months The difference noted was −0 002 mg Composite values represented by Σ (100 mg) Zr were also determined before and after intercomparisons The calibration data for the individual pieces were in agreement to the nearest microgram Control determinations on the standard centigram (S 10 mg) and their intercomparison with zirconium weights gave identical values (10 mg) Zr − (S 10 mg) = 0 000 mg

It would be advantageous to use zirconium specially for the decigram and centigram groups of weights Aluminium may still be employed for the milligram group to maintain a suitable relation between area and thickness

Strain Tester for Rubber Products

AN AUTOMATIC PRECISION STRAIN testing machine for evaluation of rubber and rubber-like compounds has been developed (*J Franklin Inst* , 1950, **250**, 62)

This tester measures the percentage elongation of a virtually motionless specimen at a definite time after the application of a pre-chosen stress This stress is determined by loading the specimen friction-free in proportion to its thickness in millimeters It predicts the cure time required to give a desired percentage elongation Precise measurement of extension set for a specified stress may be obtained since specimens can be stressed for a uniform time interval Effect of storage on elasticity can now be obtained from one batch only per cure

The machine is automatic and any unskilled operator can easily obtain all data needed for evaluations The automatic property of this tester reduces human errors to a minimum and a timer accurately controls all components of an operation cycle The maximum operation period is only 80 sec The protective controls give warning when an operation is abnormal, indicating that the data for that particular cycle are not to be used Also, no change in weight loading for a particular cycle is possible since a solenoid locks the weight combination

A Simple Microculture Slide

AN INEXPENSIVE AND EASILY manipulated slide for microscopic examination and microphotography is described (*Science*, 1950, **112**, 53)

The slide which is used in conjunction with 18 mm cover slips is a standard 1″×3″ glass slide, 3 mm thick with an unpolished channel ¼″ wide and slightly less than 1 mm deep, located ¼″ from one end of the slide Cover slips and slides are sterilized separately, and immediately prior to use a cover slip is placed over the channel without cement or wax of any kind, thus forming a small open chamber Melted seeded agar is allowed to flow under the cover slip by capillarity until part of the space is filled The inoculated culture slide may then be inoculated in a moist chamber such as a Petri dish containing a piece of moist cotton

The slide makes possible the rapid production of temporary mounts and gives satisfactory permanent mounts

New Flow Valve

A COMPACT, GLANDLESS, FLOW valve which can be remotely controlled by pneumatic, hydraulic or electrical means has been designed at the *Tilman Langley Laboratories* (*Chem Age*, 1950, **63**, 187)

The valve consists of a central body, spherical at the input end with a supply hole drilled through it The hole connects with a piston chamber at the outlet end of the component, in which moves a spherically ended and mushroom shaped piston A bypass connects the upstream end of the piston to the outlet of the valve When the bypass is closed, the pressure built up against the piston is greater than the flow pressure acting on the downstream end and this moves the piston to close the main flow Opening the bypass relieves the load on the piston which moves back, opening the flow passage to the main fluid flow

The small cross-sectional size of the valve enables it to be installed in a pipe run without requiring special clearances between adjacent pipe and the straight through flow avoids pipe bends or constrictions The valve being glandless, there is no risk of fire when inflammable liquids are handled Danger of corrosive liquids affecting the valve components is obviated since it can be fabricated from any material — even glass or carbon Without power services a remote control can be obtained by utilizing the fluid flow pressure Electrically operated, the valve will control flows of 30 g p m at pressures up to 500 p s i using only 0 33 amp from a 24 V supply

The possible applications of the valve include handling of corrosive material, remote control of water or gas supplies and fire sprinkler systems using the valve operated from fusible plugs to supply water immediately at high pressures

Newsprint from Indian Woods

INVESTIGATIONS ON RAW MATERIALS suitable for the manufacture of newsprint in India carried out at the Forest Research Institute, Dehra Dun, have revealed that satisfactory mechanical pulps can be produced from paper mulberry (*Broussonetia papyrifera*), a fast-growing broad-leaved species which can be easily cultivated on a large scale in the country (*Indian Forest Bulletin No* 143).

A series of grinding experiments on the wood were carried out to arrive at a suitable combination of various process variables which would yield news grade mechanical pulp possessing maximum strength properties Hot grinding (between

65° and 80°C) and a pocket pressure of 16 8 lb per sq in gave larger production of pulp per unit time and the pulp had better strength properties than those obtained by cold grinding Beyond 80°C and at higher pressure the pulp is darker in shade, has poor strength properties and high power consumption although the rate of production increased

Mill-scale tests made with a mixture of 70 per cent mechanical pulp and 30 per cent bleached bamboo pulp showed that the strength characteristics of the newsprint were practically the same as those of imported newsprint The colour and formation (look-through) of the experimental newsprint were superior and its quality was softer than the foreign sample The paper gave a successful printing trial except for the ink absorption which was rather high This could be brought down by proper calendering

The Indian *Picea morinda* (spruce) and *Alues pindrow* (fir) were also found suitable, but due to heavy fellings of these species from the more accessible areas and the difficulties and cost of transport from more remote areas, their utilization is considered uneconomical A detailed field survey to collect information regarding available supplies and costs of these species, delivered to a mill site is recommended to ascertain their potentialities

Battery Separators from Indian Woods

EXPERIMENTS CONDUCTED AT THE Forest Research Institute Dehra Dun, on the possibility of manufacturing battery separators from Indian woods are described in *Indian Forest Bulletin No* 147, published recently The following timbers were investigated deodar (*Cedrus deodara*), kail (*Pinus excelsa*), spruce (*Picea morinda*) and fir (*Abies pindraw*) The pretreatment consisted of boiling the separators from these woods in 2 per cent caustic soda for 2 hr followed by repeated boiling in water and thorough washing in cold water after each boiling and finally bleaching in 10 per cent sulphuric acid for 24 hr and washing Deodar needed [illegible] many as 10 washings to remove alkali Some of the separators of fir and deodar were further heated with glycerine containing 10 gm of thymol in 20 gm of lemongrass oil for 15-20 min at 115°-20°C The treatment appreciably changed the electrical resistance of the separators which compared favourably with that of Port Orford cedar (0·045 ohms) after 7 weeks' immersion Battery performance tests showed that internal resistance of the cells at the 47th cycle was of the same order and magnitude as in the case of Port Orford The discrepancies in the voltage of the cells as directly measured and as derived from the cadmium potentials of the plates were negligible The cells recorded a normal cadmium potential progress during the discharge The voltage variation at high current discharge was not erratic and the diffusion of the electrolyte was normal without any internal short circuiting Tests conducted over a period of a year and a half showed that the condition of the plates was good in the case of spruce separators and fair with those of fir The plates of cells fitted with Port Orford cedar, deodar and kail separators became brittle The bursting strengths of fir separators were the best followed by those of spruce and deodar They were better than Port Orford cedar separators in this respect Glycerine treated separators gave higher strengths Sediment deposits in Port Orford cedar were maximum, followed by deodar and kail

Resinous Wood Adhesives

TANNINS EXTRACTED FROM BARKS of *Acacia mollissima* (black wattle), *Eucalyptus crebra* (narrow leaved red ironbark), *Callitris glauca* (white cypress pine) and *Callitris calcarata* (black cypress pine) and from the woods of *Eucalyptus redunca* (wandoo) and *Eucalyptus consideniana* have been investigated for their use in the production of wood adhesives (*Australian J App Sc*, 1950, I, 54)

The rates of condensation of these tannins with 8 per cent formaldehyde were assessed by measuring the gelation times Calcarata tannin was the most reactive, a 40 per cent solution gave a gelation time of 65 min at 4 5 *pH* *C glauca*, *A mollissima* and *E redunca* tannins came next in the order of their reactivity There is a rapid change in gelation time with formaldehyde concentration up to about 10 per cent Good adhesive strengths are obtained within this range Reactivity is similar at *pH* values of 2 and 8

Adhesives were prepared by two methods In the first method a resin was prepared by heating a solution of the tannin extract or its alcohol-soluble fraction with formaldehyde in aqueous alcohol The adhesive was prepared from this resin by adding paraformaldehyde, alkali and filler The resin has a shelf life of 15 days at 25°C and of several weeks at 10°C In the second method the adhesive was obtained by adding paraformaldehyde and filler to an alkaline solution of the tannin This solution does not gel on standing but some tannins give a precipitate which can be delayed by adding glycerol

Different formulations were tried for cold press and hot-press adhesives Best cold set adhesives were obtained from *A mollissima* and *C calcarata* tannins Compared with commercial resorcinol-formaldehyde and urea-formaldehyde adhesives, these tannins require a short assembly time and have a short pot life Their bond strengths are lower except that in resistance to boiling water the tannin adhesives are far superior Satisfactory hot-press adhesives were obtained from *A. mollissima*, *C calcarata*, *C glauca* and *E crebra* tannins having shear strengths and water resistance similar to the phenolic resins used in industry They set in a short time at lower temperatures than the phenolic adhesives unless these contain a polyhydric phenol or are catalysed with strong acid The resinous adhesives require relatively little formaldelyde, the quantity varying from 4 to 8 per cent on the weight of tannin extract The drawback of short pot life is offset by the ease and simplicity of preparation

Mortars in Building Construction

A VARIETY OF MORTARS ARE USED in building work and the one chosen for any particular class of work has to be a compromise, since no one mortar possesses all the desired properties Recommendations, based on experimental trials, are given in a bulletin recently issued by the Building Research Station of the Department of Scientific Research, London (*National Building Studies, Bull No* 8, price 1*s*)

Good working qualities, water retention and freedom from major cracking are useful characteristics of mortar mixes containing lime and those with a high proportion of cement give early strength and durability A mortar containing both lime and cement has the best combination of properties, the proportions of each being varied to suit the particular set of conditions The following types of mixes to suit a variety of conditions and purposes are recommended *Brick work and block construction* Cement mortar is recommended where dense strong mortar is essential for example, bricks used for carrying heavy loads or in special constructions below ground dam-proof course *Cement-lime mortar* (a) 1 1 5-6 cement-lime-aggregate should be used with all normal types of constructions likely to be exposed to severe conditions It is not recommended for use with sand-lime or concrete bricks having a dry shrinkage greater than 0·025 per cent, (*b*) composition 1 2 8-9, cement lime aggregate is suitable for building normal brick-work in spring or summer except where the exposure conditions are severe and can also be used with sand lime and concrete bricks or concrete blocks having a drying shrinkage greater than 0·025 per cent, (c) 1 3 10-12 cement-lime-aggregate is recommended for internal work only, under spring or summer conditions This mortar has a low frost resistance and is, therefore, unsuitable for external brick-work Hydraulic lime-aggregate (1 2-3) is suitable for normal brick-work construction A richer mixture should be used under conditions of severe exposure Lime mortars (other than hydraulic) are liable to break up if they become frozen when wet, and generally should not be used for external work except for thin joints (as in masonry) or where the joints are pointed with a mortar of sufficiently high frost resistance Mortars for masonry (porous limestone and porous sandstones)—For bedding porous type of limestone or sandstone, a 1 3 lime putty crushed stone aggregate mix is suitable If a more rapid hardening isre quired, the mortar should be gauged with cement in the proportion of 1 3 12, cement lime putty aggregate For bedding dense sandstones or granite, strong mortar may be used Suitable mixes are 1 2-3, cement aggregate Rubble masonry, having a 1 2 9, cement lime aggregate mix, is suitable in spring and summer, 1 1 6, cement lime aggregate for autumn and winter

Coffee Husk as Cattle Feed

PRELIMINARY INVESTIGATIONS conducted at the Indian Veterinary Research Institute, Izzatnagar, point to the possibility of utilizing the pulpy residue from the coffee bean, now a waste material, as cattle feed Metabolic studies conducted on buffaloes after preliminary feeding of about three weeks on a ration consisting of 1 5 lb linseed cake and 3 5 lb coffee husk in the morning followed by 8 lb of wheat bran (to meet the dry requirements) gave the following digestibility coefficients for the various components crude protein, 33 53 , ether extract 76·08 , crude fibre, 18 7 and nitrogen-free extract 72 42 The nutrients in lb per 100 lb of coffee husk on dry basis were digestible crude protein, 3 38, total digestible nutrients, 42 24

During the experimental period, the animals maintained good health and no adverse symptoms were observed There was, however, difficulty in feeding the husk to the animals as they were disinclined to take it in large quantities on account of its unpleasant taste and aroma Means of increasing the palatability of the material need to be devised before it finds extensive use as a cattle feed

Sann Hemp

PRODUCTION AND MARKETING OF sann hemp in India are dealt with in a recent bulletin issued by the Agricultural Adviser to the Government of India (*Bulletin on the Marketing of Sann Hemp in India*, price Rs 1/8) Valuable improvements have been suggested to obtain better yields and quality of fibre

The area under the crop is estimated to be 5,85,000 acres with an average annual production of 1 16,000 tons fibre The average yields per acre of the fibre vary from about 3 5 md in Bombay to 4 5 md in the Madhya Pradesh and Orissa, 5 md in the Uttar Pradesh and Hyderabad, 6 md in Bihar and East Punjab, 6 5 md in Madras and 10 md in Bengal The three types of fibres are known white, *Ganjan* or green and *Dewghuddy*, which differ considerably in quality depending on the stage at which it is harvested, methods of retting and washing, and soil and climatic conditions of the area where the crop is grown

Research work on sann hemp has been confined mainly to selection of better types from the existing strains *Kanpur* 12 continues to be the best yielder Two more promising strains, *M* 18 and *M* 35, have been evolved under a scheme sponsored by the Indian Council of Agricultural Research These are early maturing varieties particularly useful in areas of scanty rainfall Experiments carried out in the Madhya Pradesh have shown that harvesting done at the pod formation stage gives the best results The fibre so obtained is superior from the point of colour, lustre and strength

Stems which are washed and dried after retting yield a finer fibre which can be extracted as and when desired This is not the case with fibre stripped from wet stems

Mathematical Typewriter

A TYPEWRITER FOR PREPARING mathematical reports has been developed at the *Aeronautical Research Laboratories*, Australia Two standard typewriters are interconnected to form a single unit thereby doubling the number of symbols available for use in mathematical work, foreign language glossaries and dictionaries and for biological papers where italics are constantly used (*Research*, 1950, 3, 378)

Two Imperial typewriters having interchangeable keyboards are bolted in an angle iron frame and adjusted at exactly the same height The left-hand keyboard has roman characters and the right-hand keyboard is fitted with mathematical symbols, Greek letters and small figures for subscripts. The tabular keys and back spacers of the two machines are mechanically linked, the former by a torsion rod and the latter by levers The plunger on the left-hand machine is operated by an electromagnet which presses on the back of the escapement mechanism operating on 10 V, D C, supplied by a rectifier The traversing motion of the carriage is controlled by the escapement mechanism of the left-hand machine A small knife switch replaces the microswitch and enables the plunger of the right-hand machine to enter into the knife switch and make sufficient contact to operate the magnet To move the carriage from one keyboard to the other, the typist merely pulls down the control bar and holding the bar in the "down" position, moves the carriage in the desired direction until it comes to rest against a stop The carriage is then in the correct position to continue typing and the bar is restored to the " up " position

Tabulation can be done on either keyboard by moving the control bar full down to throw a stop and back half way

Aluminium Alloy Castings & Sections

TWO USEFUL BULLETINS HAVE recently been issued by the Aluminium Development Association, London, dealing with *Aluminium Alloy Sections for Road Vehicle Bodies & Aluminium Alloy Castings*

To meet the requirements of road vehicle body structures, a series of aluminium alloy extruded sections have recently been developed These sections, along with others selected from the general series of aluminium alloy sections specified in B S 1161-1944, satisfy most of the requirements of body builders Simple structural forms have been adopted from these sections and the series consists of angle bars, channels, top-hats and Z-sections Altogether 32 such sections are described in the present bulletin which is supplemented by brief notes on aluminium and its alloys in their design and building

Aluminium Alloy Castings is a general survey of the various casting methods and characteristics of the different types of castings. Principles of casting design are illustrated to show how small modifications would go to improve the design of a casting and the quality of the product without affecting its cost and functional value Specified composition and mechanical properties of aluminium casting alloys and a general guide to their selections given as appendices to the bulletin enable the user to choose them to suit his requirements

Lignite Deposits in Madras

LIGNITE WAS DISCOVERED ABOUT fifteen years ago in the Vriddhacalam taluk and in the Cuddalore taluk of the South Arcot district, Madras State The total area proved is 16 sq miles

The area is occupied by Cuddalore sandstones of Miocene age composed of soft, often waterlogged sandstone grits and clays Lignite occurs as a regular bed or seam having a gentle dip (roughly 1 in 100) in an E S E direction at a depth of not less than 140 ft from the surface The average thickness found in the various boreholes of the seam is 22 ft Assuming one sq mile-foot of lignites equivalent to one million tons, the estimate of the reserve is placed at 352 million tons

Samples from the lignite cores gave on analysis the following values moisture, 9 75-35 0 per cent, volatile matter, 23 9-38 5 per cent, fixed carbon, 21 6-37 7 per cent, ash 7 4-32 9 per cent

The lignite is black and compact when freshly obtained but cracks on drying and becomes dark brown Calorific value and general assay indicate that the mineral is of good quality

Lignite seams 35 ft thick have also been encountered in the Cuddalore-Pondicherry area at a depth of 257 ft and are considered to be the extension of Neyveli field. Strata of the same age, called Varkala sandstones, occur in Travancore and continue northwards into Malabar and South Kanara lignite beds Lignite occurrences are also reported near Beypore in Malabar at the foot of a cliff, at the sea shore as well as a few other places near Cannanore and Kasargod in South Kanara

Rice Cultivation in Australia

A SURVEY RECENTLY INSTITUTED by the Australian Department of Agriculture into the possibilities of large-scale rice production in the western and northern districts of Australia has shown that factors such as seasonal flooding of areas and normal rainfall were sufficient for extensive rice cultivation making artificial methods of irrigation unnecessary, provided supplies of suitable tropical varieties of rice seed were available

Water requirements for irrigating rice fields in the Murrumbidgee area are estimated to be 6 acre-feet to the acre The actual amount required is influenced by the underlying geological and ground-water hydrological conditions, the season, the density of the crop and the layout of the field The average yield per acre for the last 11 years in this area is of the order of 1 80 tons Throughout the area the crop is grown on a poor soil, shallow-medium to heavy clay, overlying a stiff clay subsoil which previously proved unproductive when sown to other crops The same soil has produced successful yields of wheat and oats as rotational crops Even grain ripening and uniform crops have been ensured by growing two improved heavy-yielding strains of *Caloro*, originally introduced from Japan. Recently two new varieties surpassing standard commercial *Caloro* in both quality and yield have been developed *Calusa* 177 out-yields *Caloro* by half a ton to the acre and produces an even, dense crop with medium-height strong willong straw about 3 ft high *Lady Wright x Caloro* cross-bred also produces heavier crops than *Caloro* and has the advantage of medium to long grain of good quality

Manurial trials have shown that nitrogen applied as ammonium sulphate is the most satisfactory fertilizer Fertilizers are applied either through the manure box of the seed drill or combined when the rice seed is sown or big broadcastings in the rice bays after the rice has germinated

Weed growth, a serious problem, has been controlled and is eradicated by early flooding Seed is sown at a shallow depth of about 1 inch and germinated by irrigation in the usual way When the maximum germination has been obtained, the rice seedlings and weed growth are submerged to a depth of a few inches above the plant

Cutting, threshing, winnowing and cleaning operations are mechanized with the aid of headers. During recent seasons, several fore-cut automatic headers on crawler tractors have been used

Electronic Sterilisation of Foods

THE ELECTRONIC STERILIZATION OF foodstuffs is becoming an attractive proposition as the amount of energy used up in the process is small and the rise in temperature of the material is only 2 or 3 degrees. In many cases, however, serious changes take place in the food and the prevention of these changes is one of the major problems to be solved before the method can be commercialy adopted (*Food Sc Abs*, 1950, 22, 73)

X-rays, electrons or cathode rays and gamma-rays can be employed It has been found that larger organisms such as bacteria are more easily killed than smaller ones such as viruses To kill *B coli*, a dose of about 5,000γ is required, in the case of vaccinia virus, about 1,00,000γ is necessary Recent work has shown that to sterilize food contaminated with the usual forms of bacteria requires a dosage between one and two million γ units

The chief problem in producing a beam of electrons suitable for sterilization purposes is the high voltages to be employed This limits the field to two machines with a third as a future possibility First is the Van de draaf generator producing a continuous beam of electrons at 2 Mev and 250 micro-amp, which can sterilize a few grams of food in the form of a disc, 2 or 3 cm in dia, and about 0 5 cm thick, in about $\frac{1}{30}$ of a second The second type of generator is the Capacitron which delivers the beam at 3 Mev in the form of a pulse of exceedingly high intensity (about 25,000 amp) but of very short duration (about one millionth of a second) Two or three of these pulses will sterilize several pounds of food The microwave linear accelerator is the third type emitting electrons with an energy of 4 Mev By focussing the beam, a pound of food, one cm. thick, can be sterilized in about 12 sec

The large doses of irradiation which are required give rise to serious difficulties with regard to the food itself and there is risk of changes in palatability and nutritive value The more striking effects found are butter loses its colour and looks like lard, it becomes so rancid that it is inedible Fresh red meat develops a purple colour and an unpleasant, oily, burnt taste Fresh white fish loses all flavour and so does orange juice

Perennial Cottons

CONVERSION OF THE EXISTING perennial cottons into quality perennials and extending the cultivation of suitable perennials in backyards, as hedge crops, as subsidiary crops in gardens and in waste lands unsuited to food crops are some of the measures recommended to meet the demand for long staple cotton in the country (*Indian Cotton Growing Rev*, 1950, 4, 63) Environments favourable to the crop but not to the insect pests have to be created This is possible by shifts in planting and harvest dates and by developing areas where the meteorological conditions will be adverse for the pests Resistant South American types like Moco, Quebradinho and Verdao which kill the attacking grub of stem weevil in all stages and to a limited extent the wild *G thurberi* which resists boll worms, should be tried In Madras, hybrids have been evolved from crosses between Moco and improved strains of Cambodia to withstand stem weevil Five varieties from South America which were very vigorous, resistant to cotton stem weevil, long stapled and capable of standing up to periodical pruning were tested The first generation hybrids between local races of *hirsutum* and other *barabadense* types exhibited pronounced hybrid vigour, out-yielded the *nadam* type could be retained on the ground for three years with or without pruning and showed considerable resistance to stem attack Bourbon cotton, acclimatized to the South Canara district, has grown into tree-like shrubs and is reported to yield in two seasonal harvests 5 lb of seed cotton per bush

Chromite Deposits in Orissa

CHROMITE DEPOSITS ESTIMATED AT 2,00,000 to 5,00,000 tons have been found at Nausahi in Keonjhar district in Orissa by the Geological Survey of India as a result of a recent investigation conducted in the area The deposits occur in a one and a half mile long stretch of rocks in the region Proximity to the centres of iron and steel industry and to Calcutta Port makes these deposits important

Paint Factories for Madras

THE GOVERNMENT OF INDIA HAVE accepted a proposal for the establishment of a paint and a lithopone factory with a production capacity of 10 tons per day and 2,500 tons per annum respectively in Rayalaseema, Madras Investigations to assess the suitability of various localities in this area for location of these factories and the preparation of detailed plans and estimates are in progress Rayalaseema has abundant raw materials used in the manufacture of paints and varnishes and lithopone The production of these raw materials in 1948 was barytes 17,076 tons, steatite 244 tons yellow ochre 765 tons and red oxide of iron 1,075 tons

Radioactive Materials & Stable Isotopes

RADIOACTIVE MATERIALS AND STABLE isotopes from natural sources or produced by irradiation are finding extensive application in fundamental and applied research, but information on these materials is not readily available for want of a consolidated catalogue A list of the available isotopes and radioactive materials recently issued by the U K Atomic Energy Research Establishment at Harwell deals with the preparation and use of radioactive materials, advisory and field experimental services, health hazards and data on the radiations emitted by the materials β and γ ray sources for radiography and therapy are also included and details regarding packing and transport of these materials are given The users of these materials for experimental purposes are strongly recommended to discuss the experiment with a representative of Radiochemical Centre, Amersham, or A E R E, Harwell England, to avoid waste of time and prevent wastage of active material

The International Council of Scientific Unions

A DESCRIPTIVE PAMPHLET ("A Description of the International Council of Scientific Unions" Gonville and Cains College, Cambridge, England), recently published by the International Council of Scientific Unions, gives an account of the history, present status and activities of the Council and affiliated bodies and unions The information is primarily intended to stimulate the interest of nonadhering countries and organizations and the younger generation entering the fields of the natural sciences and includes the history and functions, commissions, publications, assemblies, statutes, annual contribution, member countries, existing agreements with other organizations and present office bearers

Board of Engineering Research

AT ITS INAUGURAL MEETING HELD in September 1950 under the chairmanship of Shri A N Khosla the Board of Engineering Research discussed ways and means of initiating and promoting research in various branches of engineering It was decided to undertake a detailed survey of the existing facilities for tackling problems facing state organizations and industries Five expert committees on (i) civil and structural engineering (ii) mechanical engineering including machine tools (iii) electrical and radio engineering (iv) hydraulic engineering and (v) aeronautical engineering were constituted to draw up detailed proposals regarding the lines on which research work in various branches should be initiated

The Board discussed an offer from two industrialists to donate substantial sums of money towards the establishment of two post graduate engineering research institutions A sub committee was formed to examine the proposal in detail

British Scientific Publications

THE ROYAL SOCIETY INFORMATION Services Committee have brought out a valuable handbook listing scientific journals of the United Kingdom publishing original scientific papers or critical reviews It includes a short description of the contents of the journal its frequency of issue the current volume number subscription size and other useful particulars of over 200 journals The index gives abbreviations for titles of the journals taken from the current *World List of Periodicals*

Coupled with the *Bibliography of Scientific Publications for South Asia* brought out by *UNESCO* this handbook would serve as a useful compendium for scientific workers and libraries in India The handbook is published by the Cambridge University Press and is priced 2*s* 6*d*

Announcements

Building Research Congress — British professional institutions and learned societies are sponsoring a congress on building research to be held in London from Sept 11 to 20 1951 The purpose of the congress is to review the progress made in research in relation to architecture building and the associated branches of civil engineering Papers are invited from research workers from overseas Further details are available from the Organizing Secretary Building Research Congress 1951 Building Research Station Bucknalls Lane Watford Herts England

The Registry of Rare Chemicals 35 West 33rd Street Chicago lists the following wanted chemicals phosphoryl fluoride ferric bromide (anhydrous) ferrous bromide (anhydrous) zinc carbonyl ammonium cyanide *p* amino ethylbenzene γ aminobutyric acid 2 phenylcyclohexanone 3 methylpentanol 3 acetylcyanide 5 methylisoquinoline acetyl phosphate perfluoroadipic acid *n* decyl mercaptan *n* hexadecyl mercaptan methyl vinylsulfonate methyl isopropenylsulfonate perillic acid scymnol, and coniferyl alcohol

The International Union of Geodesy & Geophysics will hold its 9th General Assembly in Brussels from 21st August to 1st September 1951

Indian Science Congress 1951 — The thirty eighth session of the Indian Science Congress will be held in Bangalore during January 1951 and not in Calcutta as announced earlier

Dr K K Majumdar Indian School of Mines and Applied Geology Dhanbad has been awarded the William Campbell Fellowship by the Columbia University and the Fulbright Travel Grant by the Government of U S A Dr Majumdar will carry out research on flotation of minerals under Prof A F Taggart at the Department of Mineral Engineering Columbia University

Dr J N Mukherjee has been appointed as the Director and the Head of the Division of Chemistry Building Research Institute (C S I R) Roorkee

Nuffield Foundation Travelling Fellowships 1951 52 — The last date for receipt of applications for the Fellowships has been changed from 31st March 1951 to 28th February 1951

Progress Reports

RICE RESEARCH

EXAMINATION OF IMPROVED TYPES OF PADDY FOR their yield performance has been an important feature of the work carried out at the Central Rice Research Institute, Cuttack, during the year 1948-49 As a result of this work two early maturing and high yielding varieties of paddy of Chinese origin suitable for cultivation under conditions obtaining in Orissa, have been discovered These varieties mature in 100 days and have been found suitable for the second crop when planted after mid-December (and transplanted within 30 days) The yields vary from 1,000 to 1,800 lb per acre thus ensuring the average total yield of about 3,000 lb per acre without manure and 4,000 lb per acre with manure

82 improved types were tested for yield performance during the year against suitable controls and 12 varietal trials were conducted Of the Orissa *beali* varieties *Benihog* gave significantly higher yield than B 76 and N 136 Plr 7 and DCA 14 recorded 25 and 23 per cent increase in manured plots over the unmanured ones China 45 and 47 and two Madras types PTB 10 and *Co* 13 gave significantly higher yields than the local *Benihog* The yield data were analysed and the genetic variability component of the progeny varieties estimated This was found to be significant at 5 per cent level in 5 established strains indicating scope for further selection in these strains

Manurial trials conducted over a period of three years for broadcast and transplanted paddy indicated a significant response to manuring by groundnut cake and ammonium sulphate Transplanting gave higher yield than broadcasting, the advantage being more apparent with the late varieties Ammonium sulphate applied in a single dose at the transplanting stage for early maturing varieties and in two doses for the late varieties gave the maximum response The average increase in yield per lb of nitrogen was 15·0 lb when applied at 20 lb per acre and 10·2 lb when applied at 40 lb per acre Application of lime also gave an average increase of 16 lb per acre for every cwt of lime applied Application of phosphatic fertilizer in general resulted in increased yields In the presence of nitrogen-fertilizers, however, phosphatic application did not give any added response

Response of the crop to spacing was investigated with two varieties, T 812 and T 1242 The yield decreased with increased spacing, 6" to 9" was found to be the optimum Trials on single and double transplanting showed that the yield from single transplanting of 30-day old seedlings was significantly higher than double transplanting of 60-day old seedlings

The Institute undertook a series of statistical studies to determine the optimum size and shape of plots, their arrangements in blocks and their comparative efficiency A 4'×4' plot had the maximum efficiency which decreased with the increase in plot size In view of the practical difficulties of using very small plots for yield experiments and the relative higher increase in C V with small plots in fields it is suggested that plot sizes ranging from 1/750 to 1/500 acre for varietal trials and sizes of 1/150 to 1/160 acre for manurial trials may be used

Mycological studies during the year were confined to *Helminthosporium* disease of rice and control of spotting in the grain The spare suspension method of artificial inoculation was not found efficacious as *H oryzae* wouldn ot sporulate under experimental conditions A new technique was evolved in which the dry mycelium along with the spores from a 21-day old culture of the fungus on grain in the husk medium was dusted on to the moistened leaves of the seedlings

Various seed treatments were investigated for their effect on the viability and germination of seeds Mercurials like Agrano, Agrosan Gn, Granosan were highly toxic in concentrations of $\frac{1}{80}$, $\frac{1}{50}$ and $\frac{1}{15}$ by weight of seed and no germination was obtained Treatment with T M T D increased the percentage of germination in Co 2 by 22 per cent

Three types of stem borers have been found to attack the rice crop in Orissa 3 *Sehoenobius incertellus*, *Sesamia inferens* and *Agyria sticticraspis* The major damage is caused by *Sehoenobius incertellus* Manuring decreased the incidence of pests Guesarol 550 (50 per cent DDT) killed all pests 4 hr after spraying while Gammexane D O 25 (5 per cent benzene hexachloride) took 8 to 10 hr Vivifex (50 per cent DDT and 30 per cent $CuSO_4$) gave the same result but the plants revived better than in other cases

The efficacy of various herbicides was examined for the control of water hyacinth and weeds in the rice fields Two sprayings of the following were found effective against water hyacinth 2 4-D acid (28 oz in 150 gal of water per acre), 2 4-D (36 oz in 150 gal of water per acre), 2 4-D sodium salt (30 oz in 150 gal of water per acre) and 2 methyl 1-4 chlorophenoxy acetic acid (15 lb in 150 gal of water per acre) 30 species of weeds in the field bunds were sprayed with methoxone (10 per cent solution), Chloroxone (80 per cent powder) and Tufor (70 per cent acid powder) Three concentrations of the chemicals were employed Spraying was done twice with an interval of 10 days between each spraying None of the grasses and *Cyperaceae* weeds was affected Weeds belonging to *Malvaceae* and *Sterculaceae* showed a high degree of response while two weeds of *Tiliaceae* were not affected All *Vitaceae* were easily affected Of the 4 wee [illegible]f *Leguminosae*, only one, i e *Sesbania aculeata*, showed some response, *Cassia tora* remained unaffected and *Mimosa pudica* was partly affected The most commonly occurring weeds, *Croton sparsiflorus* and *Euphorbia sp*, remained entirely unaffected

TIN RESEARCH

DURING THE YEAR 1949, EXPERIMENTAL WORK AT the Tin Research Institute, England, has been concentrated on improving the quality of tin plate, bronze and bearing alloys and on the electrodeposition of tin and tin alloys.

The application of the Francis thickness tester to the measurement of electrolytic and hot-dipped tin-plate coatings has been studied. An instrument built for this work has proved useful and reliable. The possibility of obtaining new bearing components by powder metallurgy are being examined as this method offers a combination of properties not obtainable by ordinary casting methods. Factors affecting the life of tin-base bearing metals are being investigated and two new machines are being set up to assess the performance of alloys. Electrodeposition of tin-alloys (tin-zinc tin-lead, tin-copper etc.), developed at the Institute, has proved useful on steel chassis of radio sets, on bolts and nuts and parts used in the cycle and automobile industries. The coatings have also been adopted as a finish for steel curtain rails, steel skates, electric signalling apparatus and heat exchange equipment. Tin-cadmium alloy is found to be rust resisting, other similar alloys are also being developed. Apparatus has been designed for assessing the importance of variables under manufacturing conditions and on the corrosion resistance of tin plate.

During the year under review, new offices of the Institute were opened in the United States, Belgium and Holland to extend the service of technical information and assistance to tin-consuming industries. The new buildings under construction at Greenford, England, to have additional space for the headquarters and laboratories are nearing completion.

Several useful publications covering all the major applications of tin have been published by the Institute during the year. Of these *Tin & Its Uses*, *Hot-tinning* and *Notes on Soldering* have evoked wide interest.

ACTIVITIES OF THE BUILDING RESEARCH UNIT (C.S.I.R.), ROORKEE

ONE OF THE IMPORTANT RESEARCH PROJECTS UNDERtaken by the Unit during the year 1949-50 was on the use of indigenous materials in building better houses at a reasonably low cost. A bulletin on this subject (*Low Cost Houses*) has been issued by the Unit. Further attempts are being made to reduce the weight of the roof tile to effect an economy in the framework. Light-weight aggregates such as overburnt bricks weighing half as much as the clay are being introduced to replace a part of the clay. Work is in progress on the utilization of lime-sludge (a factory waste) as an earth stabilizer, 2 to 5 per cent lime-sludge with 3 to 5 per cent sodium silicate has good stabilizing properties. The effects of different salts on the physical properties of soils have been studied.

Another important project initiated by the Chemistry Section of the Unit is the study of problems connected with the manufacture of bricks. A number of bricks and brick-earths from all over the country have been analysed and samples of bricks prepared under uniform conditions have been examined for their physical characteristics.

Soil survey studies were carried out in the airfield at Hindan (Ghaziabad) for the Engineer-in-Chief, Army Headquarters, New Delhi, to improve the bearing capacity of the soil.

Problems connected with prefabricated houses were investigated jointly by the Unit and the National Chemical Laboratory, Poona. A mould grease consisting of grease and graphite, castor oil and aluminium stearate has been prepared for the new concrete moulds used in manufacturing prefabricated blocks from foamed concrete. Cement-fibre boards have been made from organic fibres such as coir, sisal and jute and mastic compounds for jointing the prefabricated wall panels.

TATA INSTITUTE OF FUNDAMENTAL RESEARCH, BOMBAY

A PROGRAMME IN COSMIC-RAY RADIATION STUDIES at high altitudes with specially designed photographic plates is being undertaken by the Tata Institute of Fundamental Research, Bombay, in co-operation with Dr Peters of the Rochester University, U.S.A. The observations will be conducted at Bangalore to start with, where arrangements for the supply of large quantities of hydrogen at high pressure, required for the experiments, are available. The data so far obtained during high altitude flights with balloons at Bangalore have been analysed and the results are being published. A further programme of flights at Bangalore is to be undertaken and in addition to the flights which will be made for the study of cosmic ray intensity at high altitudes, separate flights will also be made for the study of temperatures in the upper atmosphere.

In addition to the non-recurring grant of Rs 30,000 which the Department of Scientific Research has sanctioned to the Institute on the recommendation of the Scientific Manpower Committee for increasing the laboratory facilities, a recurring grant of Rs 12,250 has also been sanctioned to the Institute for the year 1950-51 for the institution of 10 additional studentships.

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India*, Part II, Section 1, for August and September 1950

Plastics & Plasticisers

41223 Improved plastic moulding compositions *Incorporating borates of alkaline earth metal to the extent of 1 to 20 per cent by the weight of resin* — I C I Ltd

Organic Chemicals

42767 Manufacture of sulphuric esters of the leuco derivatives of vat dyestuffs and anthraquinone dyestuff intermediates *Reacting leuco derivatives of vat dyestuffs and anthraquinone dyestuff intermediates Reacting the leuco derivatives of vat dyestuff with SO_3 in presence of N-alkylphthalimidine* — I C I Ltd

42853 New vat dyestuff *Condensing a α-dichloroacedianthrone with two molecular proportions of 6-amino-3′ 4′-phthaloyalacridone*—I C I Ltd

43288 Preparation of acetals *Condensation of alcohol and aldehyde is effected in the presence of a liquid which forms an azeotropically boiling mixture with water and one or more of the reactants* — Ruhrchemie Aktiengesellschaft

41922 Oxidation of paraffinic hydrocarbons *The paraffin is treated with nitro gases and nitro-sulphuric acid containing 70 per cent to 90 per cent H_2SO_4* — Ruhrchemie Aktiengesellschaft

Miscellaneous Chemicals

40968 The manufacture of a therapeutically active antibiotic preparation containing Pristimerin and Dulcitol from *Pristimera indica* (Willd), A C Smith, syn *Hippocratea indica* Willd (*Celastraceae*) *Roots of Pristimera indica are extracted with an organic solvent other than petroleum ether*—S S Bhatnagar, Divekar & Dutta

40969 Manufacture of Dulcitol *Roots of Pristimera indica are extracted with an organic solvent and thereafter Dulcitol is crystallized from the solvent* — S S Bhatnagar, Divekar & Dutta

Fuels & Lubricants

41722-23 Arrangement for cleaning producer gas *A chamber having gas inlet and provided with holes which break the gas into jets and then bubbling the gas through water Consists of a cyclone with an inlet for the gas to be cleaned, a pipe connecting the bottom of the cyclone with a reservoir containing water* — Das Gupta & Khanna

Metals & Metal Products

43279 Continuous casting process and apparatus *Pouring molten metal into one end of an open-ended fluid-cooled stationary mould, withdrawing the casting from the opposite end and co-ordinating the pour-rate of the metal with the withdrawal rate of casting to cause continuously a cyclic change in the molten metal level within the mould* — The Babcock & Wilcox Tube Co

42075 Improved tin and tin alloy plating bath *Comprising 60 to 85 per cent by weight of 4-4 dihydroxy diphenyl sulphone, balance 2-4′ dihydroxy diphenyl sulphone* — Carnegie-Illinois Steel Co

44301 Production of zinc *Using a circulating readily fusible metal alloy as a cooling medium for a pool of the molten metal* — The National Smelting Co Ltd

Rubber & Rubber Products

41611 Production of metal reinforced resilient rubber rings and appliances embodying the same *Supporting a metal spring coiled in a closed circle within an annular moulding space and filling the moulding space with unvulcanized rubber and vulcanizing* — Latex Industries Ltd

Stone, Clay & Glass Products

41016 Manufacture of refractory material *Employing a composition containing calcined fireclay, plastic fireclay and alkali* — The Tata Iron & Steel Co Ltd

Textile & Textile Products

41843 Single yarn hand sizing machine *Yarn passed through sizing material is spread evenly on a winding frame by means of rotatable screw rod engaging a traverser, the screw rod and the handle adapting the winding frame being connected by means of chain or gear wheels or belt and pulley for drive* — Perez

43309 Weft-winding machine *To each bobbin winding point corresponds a single control member for operating all control phenomena said control member being driven by one driving member common to all* — Baumgartner

43538 Fibre drafting elements used in textile spinning *Fibre drafting element being composed of finely cellular oil-resistant synthetic rubber having unruptured gas-filled cells* — George Angus & Co Ltd

Miscellaneous

43000 Machine for harvesting potatoes and other root crops *Consisting of a lifting share, an elevator and an angularly disposed conveyer in which the harvesting machine is detachably connected to the tractor* — Crawford

42802 Compositions for sealing electric storage batteries *Asphalt 99 to 80 per cent by weight, rubber 1 to 20 per cent by weight, rubber in the form of latex containing 30 to 60 per cent rubber solid* — The Electric Storage Battery Co

Patented Inventions of the Council of Scientific & Industrial Research

COPPER-SILICON BRONZES

Patent No 36182

D R MALHOTRA, B PRAKASH & B D AGRAWAL

COPPER-SILICON BRONZES ARE TIN-FREE ALLOYS possessing physical and chemical properties similar to tin-bearing alloys They are stronger, more ductile and corrosion resistant than tin-bearing alloys and practically all articles at present being made of tin-bearing alloys can well be made of copper-silicon bronzes, which are, moreover, cheaper to produce It is essential to develop such tin-free alloys in India as the country is deficient in tin

The process for the manufacture of copper-silicon bronzes consists in preparing an alloy containing copper, silicon, manganese and iron, adding the " hardner ' thus prepared to molten copper and heating the molten metal to allow alloying, with or without the addition of zinc in the end The metal is then deoxidized with phosphor copper (15 per cent phosphorus) and cast in sand or metal moulds It is very necessary to maintain neutral or reducing atmosphere during melting Fused borax is used as a flux along with the deoxidizer

MANUFACTURE OF BENZIDINE

Patent No 32486

B B DEY T R GOVINDACHARI &
S C RAJAGOPALAN

BENZIDINE IS AN IMPORTANT INTERMEDIATE FOR dyestuffs and is also used in rubber vulcanization, detection of sulphates in water and identification of blood

Among known methods of producing benzidine is the electrolytic reduction at a current density of about 10 amp sq dm of nitrobenzene in alcoholic solution or in a solution of potassium or xylene sulphonates This method has been found to be uneconomical and unsuitable for large-scale production

The patented method is an attempt to overcome these drawbacks It consists in the reduction of nitrobenzene in caustic alkali solution in presence of a catalyst such as lead oxide and is characterized in that the current density used is 4 amp or less per sq dm The strength of the alkali solution is 4 to 20 per cent by weight and an immiscible solvent is employed towards the end of the process to ensure the fullest possible reduction The process is carried out in an electrolytic cell made of the sheet of metal (cathode) inside which are placed porous diaphragms containing the anodes The electrodes are made of sheet iron or monel metal The porous diaphragms are made of china clay, asbestos or cement

The current efficiency of the process is only 50 to 60 per cent when reduction is carried out at a current density of 10 amp sq dm It is 90 per cent at 4 amp sq dm and 95 per cent at 2 amp sq dm

MANUFACTURE OF *PARA*-AMINOPHENOL

Patent No 33078

B B DEY, T R GOVINDACHARI &
S C RAJAGOPALAN

Para-AMINOPHENOL HAS AN EXTENSIVE RANGE OF applications including its use as a valuable dye intermediate and as a photographic developer

The present invention provides an improved process for the manufacture of para-aminophenol by the electrolytic reduction of nitrobenzene and is characterized in that the reduction is carried out in the presence of mercury and/or cerium or their salts The minimum amount of mercury or cerium salt to be used is ½ to 1 per cent of the weight of nitrobenzene

The apparatus consists of a cell of which the cathode chamber is a vessel made of copper, monel or nickel A copper salt is also added when platinum, tin or graphite is used The vessel is provided with stirrers The anodes are of lead and dip into porous diaphragms containing the anolyte

Sulphuric acid 20 to 50 per cent strength, is used as catholyte A composition consisting of 4 2 litres of H_2SO_4 (d 1 2), 5 gm mercuric sulphate and a kilo of nitrobenzene will serve as a satisfactory catholyte The anolyte may be sulphuric acid of any strength between 10 and 60 per cent The reduction is carried out at a current density of 2 to 4 amp sq dm at 80° to 100°C Total yields from 1 kg of nitrobenzene are 530 to 540 gm of aminophenol and 150 gm aniline A current yield of more than 85 gm of aminophenol per kW hr is obtainable and the method fulfils the requirements of a good electro-chemical process

Central Food Technological Research Institute*

AMONGST the research institutes which the Industrial Research Planning Committee, under the Chairmanship of Sir Shanmukham Chetty, suggested should be brought into being, was the Central Food Technological Research Institute. Research in this institution was envisaged to cover the field of scientific investigations connected with foods and their relationship to man. As such it embraced a large number of scientific disciplines including several branches of applied sciences and technology. When the objectives of this institute were deliberated upon by the Council of Scientific & Industrial Research and the Planning Committee, which had representatives of Industry, Science, Food and Agriculture Ministries in it, the following facts were prominently before them. A number of industries connected with the processing of food had already been established, for example flour milling, rice milling, bread and biscuit making, fruit and vegetable processing, country spirits and potable liquors, starch and vegetable oils including *vanaspati*, cocogem and margarine. The total value of factory production during the years 1946 and 1947, for which accurate data are available, was Rs 112.68 crores and Rs. 131.07 crores respectively, the figures of individual items being

		1946		1947
		(in lakhs of rupees)		
Flour milling		1,270		770
Rice milling		3 524		3,464
Biscuit making		192		244
Fruit and vegetable processing		32		21
Country spirits and potable liquors		214		188
Starch		47		26
Vegetable oils including		5,989		8 394
Vanaspati	2,056		1,655	
Margarine	5		8	
		11,268		13,107

In addition to the processing and production in India itself, trade in food materials forms an important feature of India's export and import trade. The volume of this trade will be apparent from the following figures which relate to the last three years, 1947-48, 1948-49 and 1949-50

	1947-48	1948-49	1949-50
	(in lakhs of rupees)		
Imports			
Fish excluding canned fish	10	15	20
Fruits and vegetables	390	585	669
Grains, pulses, flour	2 296	7,323	9,955
Liquors	210	168	108
Provisions and oilman's stores	653	705	769
Spices	363	442	354
Other foods and drinks	290	204	134
	4,212	9,442	12,012
Exports			
Fish	169	147	186
Fruits	544	610	753
Grains and pulses	12	5	4
Liquors	4	3	1
Provisions and oilman's stores	54	86	62
Spices	638	546	1,818
Other foods and drinks	49	4	107
	1,470	1,401	2,931

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* From the address delivered by Dr Shanti Swarup Bhatnagar, F R S, on the occasion of the opening of the Central Food Technological Research Institute, Mysore, October 21, 1950

These figures show that the transactions at home and abroad involve an annual turnover of rupees 225 to 240 crores

An industry and trade catering to business of this magnitude can never hope to develop and progress without the aid of research It must have the assistance of an up-to-date technological research institute to enable it more adequately to meet the needs of our people and boldly to face the competition of other countries To compare the functions of such a research institute with those of agricultural research institutes, which largely concern themselves with soil surveys, increasing production of crops and evolution of new varieties of resistant plants, would only be evading the issue, for there is very slender connection, if any between research for technological processing and research for increasing agricultural production New food industries such as the manufacture of breakfast cereals and food yeast are being established in the country and for their proper development a Central Food Technological Research Institute is a real necessity

During recent years after the separation of Burma and particularly after the division of our country, the food problem has staggered us as no other problen has The Government has spent enormous sums of money in procuring food from abroad and in increasing food crops by utilizing all available lands If the statistics which are available can be relied upon, we have an overall shortage of a little over 10 per cent of our total requirements of food

Larger shortages if any, in certain regions are due to lack of proper transport and procurement facilities To overcome this small shortage, the Government have initiated the ' Grow More Food ' campaigns, the purchases outside, the procurement drive inside and a system of rationing for principal food materials I should not say they have neglected but they have certainly laid much less emphasis on the more prudent utilization of our raw materials of food or reducing losses during storage and in industrial processing, and on the prevention of ravages by insect pests and fungi after crop collection The possibilities of introducing new processed materials which can be used as food have received the least attention All measures for increasing the growth of food, both in the vegetable and the animal kingdom, are praiseworthy The " Grow More Food " campaign will evidently require more money and time than the aids which technology can render to food preservation and food utilization The losses incurred in the inefficient milling of rice and flours on the large scale as well as in the making of parboiled rice and other parched semi-parched, baked and cooked foods are pretty large and can be decreased by the aid of technical supervision and research

We feel that by introducing substitute foods in which technological research has already shown the way and by preventing losses of food materials during storage, science and technology can help to convert our shortage of 10 per cent perhaps into a surplus

Today s inauguration of this Institute is the first big step which the Government of India have taken to solve the food problem by the technological as distinguished from purely biological methods

Although work in the laboratories was started only recently, the Institute has already some useful contributions to its credit Particular attention has been directed to the production of emergency foods to meet our urgent needs and also to utilize food materials which are now going to waste in certain seasons The Biochemistry and the Processing Divisions have been concentrating on the production of suitably fortified grains prepared from different starch-bearing materials, pulses and seed cakes Till recently the greatest difficulty was the improvement of the cooking quality but this has recently been overcome Other investigations relate to the possible application of lucerne now used only for animal feeding, but which is a high class article of food, supplying practically all the food essentials which are lacking in the ordinary cereal diets Work on the utilization of jackfruit and citrus fruits which are produced abundantly in the Malnad regions, all along the Western Ghats, is actively in progress and the industries are also taking very keen interest in the new developments Work on the processing and preservation of juice and pulp from cashew fruit has also been carried out Other enquiries bearing on the utilization of different seed-cakes, processing of coarse grains to render them acceptable to rice eaters, preservation of raw, sliced mango for chutney and pickling, curried vegetables, production of good class vinegar from different sources as a cheap cottage industry, canning of meat products, new and improved methods of processing of pulses without affecting their nutritive value, production of an attractive edible milk from groundnut, etc , are in progress The Institute has established contacts with the various food industries to whom information, advice and assistance are being given

The National Science Foundation, U.S.A.

THE National Science Foundation has been created as an independent agency in the executive branch of the United States Government to develop a national policy for the promotion of basic research and education in the sciences

The bill authorizing the establishment of the foundation was signed by President Truman on May 10, 1950 Described by the President as a " major landmark in the history of science in the United States ", the creation of the Foundation climaxes five years of effort to develop a sound instrument for promoting progress of science

" We have come to know that our ability to survive and grow as a nation depends to a very large degree upon our scientific progress ", the President said in signing the bill " Moreover ", he continued, " It is not enough simply to keep abreast of the rest of the world in scientific matters We must maintain our leadership The National Science Foundation will stimulate basic research and education in nearly every branch of science, and thereby add to the supply of knowledge which is indispensable to our continued growth, prosperity and security "

As provided in the bill, the National Science Foundation consists of a director and a 24-member board, all of whom are appointed by the President with the advice and consent of the Senate Persons nominated must be eminent in the fields of basic sciences, medical science, engineering, agriculture, education, or public affairs, with their selection based solely on the basis of established records of distinguished service The term of office of the voting board members is six years.

The general functions of the Foundation, as described in the bill, are as follows

> To develop and encourage the pursuit of a national policy for promoting basic research and education in the sciences ,
>
> To initiate and support basic scientific research in mathematical, physical, medical, biological, engineering, and other sciences, by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such basic scientific research and to appraise the impact of research upon industrial development and upon general welfare ,
>
> To initiate and support specific scientific research activities, at the request of the Secretary of Defence, in connection with matters relating to national defence by making contracts or other arrangements ,
>
> To award scholarships and graduate fellowships in mathematical, physical, medical, biological, engineering, and other sciences ,
>
> To foster interchange of scientific information among scientists in the United States and foreign countries ,
>
> To evaluate scientific research programmes undertaken by agencies of the Federal Government, and to correlate the Foundation's scientific research programmes with those undertaken by individuals and by public and private research groups ,
>
> To maintain a register of scientific and technical personnel and in other ways to provide a central clearing house for information covering all scientific and technical personnel in the United States, including its territories and possessions

Four main divisions, with committees set up for each, were outlined within the Foundation . the Division of Medical Research , of Mathematical, Physical and Engineering Sciences , of Biological Sciences , and of Scientific Personnel and Education

The bill authorizes the Foundation to cooperate " in any international scientific research activities consistent with the purposes of the Act " and to expend for such international research sums within the limit of appropriated funds Such arrangements, however, must meet with the approval of the Secretary of State and be consistent with the foreign policy objectives of the United States

Recipients of scholarships and graduate fellowships for scientific study will be selected by the Foundation from among United States' citizens on a basis of ability

Commenting on the bill, Washington *Star* says the prime responsibility of the Foundation is " to mobilize the nation's brains — our richest natural resource — for a co-ordinated and continuing programme of basic research calculated to keep us from lagging behind any other country in the age of the atom and kindred good and evil wonders The Foundation is designed to perpetuate and enlarge upon the kind of work that was carried out with brilliant results by the temporary wartime Office of Scientific Research and Development Once it is established and operating, however, its activities will cover far more than national defence, though that will be one of its major responsibilities Actually it will have something to do with virtually every type of experimentation, not merely in military science but in medicine, physics, engineering, biology and similar fields, bearing upon the health and economic well-being and safety of America Among other functions, it will serve as a clearing house for technical information, grant scholarships and fellowships to make the most of available talent and offer close co-operation — including grants and loans — to universities and other institutions engaged in fundamental studies

" In terms of both national security and beneficent peacetime progress, such an enterprise unquestionably is full of great potentialities Despite all that has been accomplished already, frontiers of science still remain largely unexplored With the projected new Foundation in vigorous operation acting simultaneously as a stimulator and co-ordinator of exploratory experiments and of efforts to make practical applications of new discoveries, there will be good reason to expect rich dividends from whatever we invest in it The sooner we have it as a going concern, the better equipped the nation will be to serve its own best interests "

Although the Foundation machinery has been established, to date the director and the board members have not been named

U.S.I.S.

Some Basic Industrial Problems Requiring Scientific Investigation on Priority Basis

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INDUSTRIAL development in India has so far been generally based on the utilization of processes developed in other countries and sometimes without adequate consideration being given to the suitability of adopting such processes to Indian conditions and/or natural resources. Planned economic development of a country necessitates a correct appreciation of the limitations of available resources and their optimum utilization

It will be appreciated that unless the basic chemical industry is developed keeping in view our resources, particularly in respect of raw materials, the entire superstructure would be unsound. Manufacture of mineral acids — sulphuric, hydrochloric and nitric—, soda ash, caustic soda and fertilizers, and proper utilization of our fuel resources are some aspects of the chemical industry which require careful scrutiny Unfortunately, our sulphuric acid industry is still based on imported sulphur Both because of insufficient knowledge and information in regard to the alternative sources of sulphur-bearing materials in the country and the reluctance on the part of *entrepreneurs* to the adoption of new processes, regarding which both they as well as the technicians of the country have still insufficient knowledge and experience, no attempt has been made to study and adopt the more recent techniques in other countries It is not only necessary to keep ourselves abreast of the times and take advantage of all scientific and technological developments in other countries for securing advantages, but also it is essential to engage ourselves on a priority basis in the development of new processes for utilizing our own raw materials as far as possible

While the scope of fundamental scientific research having a long-term utility has to be mainly determined by the ability of the individual worker to think and plan his work, industrial investigations have to be taken up on a priority basis consistent with the immediate requirements of the country In the long run, it is necessary for us to spend the maximum available funds for industrial research and to solve immediate industrial problems by concerted action on the part of a number of investigators interested in specific fields and allocation of the entire financial resources to specific problems on a priority basis.

Having some of these aspects in view, an attempt has been made to indicate below some of the basic industrial problems which may have to be assigned the highest priority and on the solution of which the development of some of our basic chemical industries will depend.

Sulphur Resources

(1) Recovery of sulphur from gypsum *either* by reduction to sulphur dioxide and further reduction to sulphur, *or* by reduction to calcium sulphide, generation of hydrogen sulphide and its oxidation to sulphur (2) Use of gypsum for the manufacture of sulphuric acid. (3) Utilization of sodium sulphate for (a) manufacture of sulphuric acid, (b) manufacture of ammonium sulphate and sodium carbonate and (c) manufacture of caustic soda by causticizing Large sodium sulphate deposits are known to occur in Jodhpur at Didwana, and it may form a suitable raw material for this purpose.

(4) Electrolysis of sodium sulphate to recover sulphuric acid and caustic soda. (5) Use of magnesium sulphate (from sea water) for the manufacture of sulphuric acid (6) Use of magnesium sulphate (from sea water) for producing sodium sulphate by interaction with sodium chloride

This investigation is considered necessary to enable us to have ready information on the possibilities of producing sodium sulphate from alternative sources in the event of results under 3 and 4 proving fruitful, and the deposits at Jodhpur are considered inadequate (7) Beneficiation of calcium sulphate occurring in the form of selenite in some parts of the Union (8) Beneficiation of gypsum recovered from sea water, and (9) beneficiation of pyrites occurring in different parts of the country (deposits at Chitaldrug in Mysore State and others in Bihar, etc)

Alkali Resources

(10) Recovery of sodium carbonate and sodium sulphate from Sambhar Lake utilizing bitterns left over after the manufacture of salt It may be worth while also to take up investigations on the recovery of sodium carbonate from Chilka Lake, and (11) manufacture of ammonium chloride and sodium bicarbonate utilizing ammonia, carbon dioxide and salt

Utilization of Chlorine

(12) Manufacture of phosphatic fertilizers, particularly dicalcium phosphate, utilizing hydrochloric acid obtained as a byproduct during organic chlorinations or by manufacturing it specially from chlorine and hydrogen in caustic soda-chlorine plants, and (13) chlorination of alcohol to obtain diverse organic chlorine compounds (solvents, plasticizers, etc)

Phosphate Resources

(14) Beneficiation of apatite ore for use in the manufacture of phosphatic fertilizers, and (15) investigation into the conversion

of Indian phosphatic raw materials to phosphatic fertilizers without using sulphuric acid — by adoption of thermal treatment or by T V A process.

Miscellaneous

(16) Generation of water gas from reactive cokes (other than hard coke) produced from low grade coals and design of suitable gas generators. (17) Improvements in plant and methods for generating producer-gas from wood or charcoal for use in transport vehicles (18) Modification of petrol engines for trouble-free operation with pure alcohol or alcohol-petrol mixtures (19) Comparative studies on the use of different nitrogenous and phosphatic fertilizers — ammonium sulphate, ammonium chloride, ammonium nitrate, ammonium phosphate, urea, calcium nitrate, single and triple superphosphate, dicalcium phosphate — for different crops under different soil conditions, and (20) development of processes for the manufacture of pulp for use in rayon and staple fibre manufacture, starting from different raw materials — straws, reeds, bamboo and woods — available in India

Investigations of these problems should be continued until the completion of the pilot-plant stage and, if possible, a full-scale plant trial should be carried out after the economic possibilities of the processes are assessed by pilot-plant work

The above list is by no means exhaustive The writer is convinced that some of the problems indicated are of great national importance and their investigation should be given a very high priority Valuable investigations on some of the above problems have been carried out both in India and abroad, the object, however, of raising the issue now is only to invite attention to the urgent necessity of collecting further technological data with a view to determining the economics of some of the possibilities and for facilitating the design of industrial plant and equipment for adoption in the country

Census of Medical Men

THE SECOND IN THE SERIES OF PUBLICATIONS issued by the Council of Scientific & Industrial Research under the title *National Register of Scientific & Technical Personnel in India* to provide a continuous census of scientific manpower in the country catalogues the names of medical graduates, medical licentiates and dentists The volume (Volume II — Medical Personnel, Part I, March 1950, Price Rs 12) includes in brief outline, academic qualifications, postgraduate training, hospital work, specialized practice, teaching, research and administrative experience, etc, of qualified medical personnel in India A classified statement of the number of specialists under different categories of the profession is included at the end of the volume, which also gives information on Indian doctors residing in foreign countries, teaching and research institutions in India, hospitals for the treatment of special diseases, and a brief account of the progress of medical research in the country

Medical men who have not registered themselves so far are invited to send in their particulars and help in making the compilation exhaustive

Copies of the volume are obtainable from the Chief Editor, Dictionary of Economic Products & Industrial Resources of India, 20 Pusa Road, New Delhi

Characteristics of the Ionosphere over Calcutta (September 1950)

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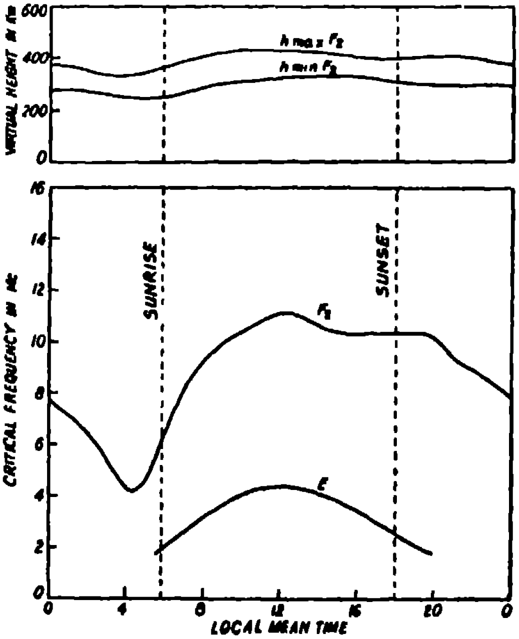
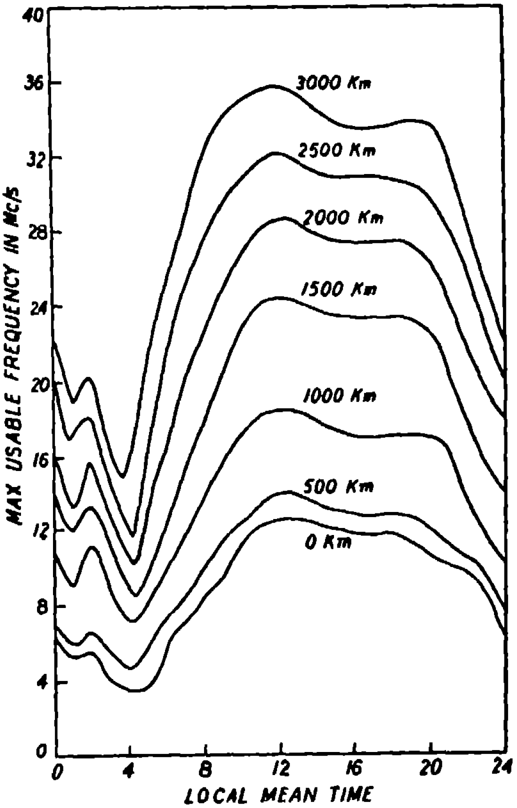
THE monthly average characteristics of the ionosphere over Calcutta for September 1950 have been presented in this note Fig 1 shows in graphical form the average diurnal variation of $f^\circ E$, $f^\circ F_2$, $h_{max}F_2$ and $h_{min}F_2$. Fig. 2 gives the prediction of the maximum usable frequencies which can be used for different distances of transmission by reflection at the F region over Calcutta for the month of December 1950 Table I gives the various occasions during routine observations when sporadic E ionization was observed and the corresponding values of penetration frequencies and heights.



(5 HR 54 MIN AHEAD OF G M T)

FIG 1 — SEPTEMBER 1950



AT POINT OF REFLECTION

FIG 2 — PREDICTED M U F VIA F_2 LAYER DURING THE MONTH OF SEPTEMBER 1950

TABLE I

MONTH & YEAR	DATE	HOURS	$f^\circ E_s$ Mc.	$h E_s$ Km.
September 1950	1	17.00	8 85	105
		18.00	6 80	105
		19.00	7 25	90
		20.00	4 20	90
		21.00	2 50	90
		23.00	6 00	90

TABLE I — *contd.*

MONTH & YEAR	DATE	HOURS	$f^{\circ}E_s$ Mc.	$h'E_s$ Km.
September 1950	2	03 00	4 50	90
		04 00	3 25	90
	4	16 00	5 30	105
		17 00	5 25	105
		18 00	4 80	90
		22.00	4 30	90
		23 00	2 70	90
	5	00.00	4 20	90
		01 00	4 00	90
		02.00	4 00	90
		03.00	3 90	90
		04 00	3 20	90
		16.00	4 10	105
		17 00	4 00	105
		19 00	4 00	90
		23.00	4 70	90
	6	02.00	7 30	90
		03.00	8 00	90
		04 00	2 95	90
		09 00	6 00	105
		10.00	9 00	120
		22.00	8 50	105
		23.00	8 50	105
	7	00 00	6 30	105
		08.00	4 60	120
		09 00	4 85	120
		10.00	4 80	120
		11 00	5 00	135
		19 00	4 00	105
	8	18.00	4 10	105
	9	10 00	4 75	105
	12	19 00	4 00	105
		20.00	3 60	105
	13	01 00	3 50	90
		02.00	3 75	90
		03.00	3 65	90
		04 00	4 80	90
		19 00	3 50	105
	15	00 00	5 50	105
		08.00	5 00	90
		17 00	8 00	120
		18.00	6 25	105

TABLE I — *contd.*

MONTH & YEAR	DATE	HOURS	$f^{\circ}E_s$ Mc.	$h'E_s$ Km.
September 1950	15	19 00	3 70	105
		20 00	4 00	90
		21 00	3 00	90
		22.00	2 25	90
		23 00	2 50	90
	16	00 00	3 40	90
		01 00	2 00	90
		02.00	2 00	90
		04 00	3 25	90
	18	23.00	3 10	90
	19	00 00	3 00	90
		01 00	3 30	90
		02.00	4 00	90
		03.00	3 15	90
		18.00	3 60	90
		20.00	3 90	90
	20	19 00	4 10	105
		20 00	4 10	90
	21	09 00	4 50	105
		19 00	2 80	90
		20 00	2 75	90
		21 00	2 50	90
		22.00	2 00	90
	23	04 00	3 00	90
		10.00	4 70	105
	27	08.00	4 05	105
	28	18 00	3 50	105
		22 00	5 10	90
		23.00	4 80	90
	29	01 00	4 30	90
		03.00	4 40	90
		04 00	3 10	90
		17 00	3 60	105
		18 00	3 60	90
		19 00	2 70	90
		20 00	3 75	90
		22.00	4 50	90
	30	04.00	4 25	90
		05 00	4 50	105
		06.00	3 05	105
		07 00	4 00	105
		10.00	4 95	105

Post-Doctorate Fellowships — National Research Council, Canada

THE NATIONAL RESEARCH COUNCIL OF Canada invites applications for the award of 34 post-doctorate research fellowships in the following branches of chemistry and physics in their laboratories at Ottawa *Chemistry* — Chemical kinetics and photochemistry, surface and colloid chemistry, molecular spectra, low temperature calorimetry, alkaloids, mechanism of organic reactions, absorption spectra of organic compounds, physical properties of gases, critical temperature phenomena and liquid structure *Physics* — Molecular spectra, molecular beams, cosmic rays, X-ray diffraction, ultrasonics and properties of matter, microwaves, optics, radiology and theoretical physics

The fellowships, of $ 2820 each per annum, are tenable for a period of one year but may be renewed for a second year. Travelling expenses will be paid to persons coming from abroad Applications on the prescribed form obtainable from the Secretary, Laboratories Awards Committee, National Research Council, Ottawa, or from the Chief Scientific Liaison Officer, National Research Council of Canada, Africa House, Kingsway, W C. 2, London, should reach Ottawa not later than February 15, 1951.

The Central Food Technological Research Institute, Mysore — Opening Ceremony, October 21, 1950

THE Central Food Technological Research Institute, Mysore, was declared open by the Hon'ble Sri C Rajagopalachari, on October 21, 1950 The Rajpramukh, the Maharaja of Mysore, presided The function, which took place in a special pandal at the Cheluvamba Mansions, was attended by eminent men of science, officials of the Central and State governments and prominent citizens

The Institute, the fifth in the chain of national laboratories declared open this year, is housed in the magnificent Cheluvamba Mansions, which was taken over by the Government of India in April 1949

The establishment of the Institute was recommended by the Industrial Research Planning Committee of the Council of Scientific & Industrial Research in 1945 The Governing Body of the Council sanctioned the necessary expenditure for formulating detailed plans for the Institute in February 1948 The formal agreement regarding the location of the Institute at the Cheluvamba Mansions, Mysore, was reached in December 1948, and the work connected with the planning and organization of the laboratories was entrusted to Dr V Subrahmanyan, since appointed Director of the Institute The arrangements for converting the palace into a laboratory commenced in April 1949, and before the end of the year, the Biochemistry and Nutrition Divisions and a section of the Processing Division were actively functioning Early in 1950 the Indian Institute of Fruit Technology was merged with the Institute and by July of the same year the Division of Fruit Technology was fully organized, not only for carrying out researches on the preservation and processing of fruits and vegetables, but also for conducting the All-India Postgraduate Diploma Course in Fruit Technology

Declaring the Institute open, Sri C Rajagopalachari paid a tribute to the work of Dr Shanti Swarup Bhatnagar in speedily establishing the national laboratories in the country He drew attention to the vast scope for research in solving the food problems facing the country, and suggested that scientific research and technological processes should be employed to minimize all forms of food wastage and to preserve all surplus food material "Another field for investigation", he said, "is the elimination of the harmful constituents of non-edible materials, and the conversion of the latter into healthy and attractive food This also is a vast and very important field of investigation in the plan of supplementing our food resources. Closely linked up with this is the maintenance of nutritional standards by the use of staple subsidiary foods There is again the problem of the manufacture of concentrated foods and accessories like vitamins on a large scale which would assist the maintenance of proper nutritional standards in India"

In his speech the Rajpramukh, the Maharaja of Mysore, observed that the importance of food cannot be over-emphasized in a poor under-nourished country like India "This Institute", he observed, "is one amongst the many enterprises that are evidence of the innate constructive genius of our Nation Our Government, since the advent of Swaraj, has been trying to liquidate the arrears of centuries in the matter of scientific, industrial and material progress Think of the many research laboratories it has organized, of the many dams and reservoirs it has planned for the conservation of waters needed in our dry and droughty land, of the many power stations that are in the stage of planning or actually under construction for the improvement of the economic condition of our people, of the encouragement it has given to shipbuilding, and of the many research laboratories — pure and applied — it is establishing all over the country and the stimulus and support it has given to research and creative activities" Speaking of the conservative food habits of the people of

India and how the people at large are apt to be reluctant to utilize new food products, he stressed the rôle of educated and upper strata of society in setting an example by betaking to such food products

Dr S S Bhatnagar, in an illuminating address on the occasion, briefly traced the circumstances leading to the establishment of the Institute, and observed, "To-day's inauguration of this Institute is the first big step which the Government of India have taken to solve the food problem by the technological, as distinguished from the purely biological, methods New food industries such as the manufacture of breakfast cereals and food yeast are being established in the country, and for their proper development, a Central Food Technological Research Institute is a real necessity" He assured the gathering that within a year of its inauguration, the Institute will make distinct contributions towards the solution of food shortage in India He paid a tribute to the work of Dr V Subrahmanyan, who has worked zealously and hard to establish, as quickly as possible, this new aid to food industry

In his message Pandit Jawaharlal Nehru, the Prime Minister of India, referred to the scientific developments in the country during the past few years and said "One of the remarkable developments in India, during the last three years, has been the opening of national laboratories and research institutes We have put up some magnificent laboratories, not only impressive to look at, but I hope, the homes of productive effort and work It is ultimately on the basis of work done in our research institutes and laboratories that we can progress in most directions Thus far we have depended on other countries and have merely copied them or taken advantage of something that they have done We cannot go far with this dependence We have at least laid good and true foundations for scientific progress It is for the young scientists of India to take advantage of the great opportunities offered to them and thus help in building up the New India

"We have given top priority to the production of foodgrains or subsidiary foods It is obvious that food is of the first importance and its value cannot be judged merely in money terms We cannot depend on imports for our food and, therefore, we have laid down a target for food sufficiency This is the 1951-1952 season In spite of all difficulties and disasters, we still adhere to that target and are trying to work up to it We hope to succeed It must always be remembered that food production has the highest priority

"How can science help in this? The primary responsibility is of our Department of Agriculture Science can help in agriculture greatly It can also help in various other processes It is particularly with these other processes that this Institute will be concerned I hope the work done in this Institute will bear fruit not in developments on paper and in scientific journals but in terms of human values and in increase of suitable food for our people"

The functions of the Central Food Technological Institute include (1) development of improved methods of storage, refrigeration, freezing, gas storage, dehydration, canning, etc, study of biochemical and microbiological changes accompanying spoilage, reclamation and utilization of infested or otherwise affected food materials, (2) processing of foodstuffs with a view to (a) facilitating their ready usage, and (b) improving their keeping quality, treatment of coarse materials to improve palatability, digestibility and food value, elimination of harmful and unpalatable ingredients from food materials, (3) study of new and unfamiliar sources of food materials and processing of new materials to render them suitable for human consumption, emergency foods, survey of potential food resources in different regions, (4) production of concentrated foods, vitamins and other food accessories, composite multi-purpose foods, supplementary foods, substitutes, etc, (5) dietetics, design and demonstration of improved types of food preparations to suit the economic conditions and sentiments of people in different regions, studies on cooking utensils, improved cooking methods with a view to saving in labour and minimizing the consumption of fuel, (6) study of problems relating to food industries, provision of technological information required by industry, survey of existing industries and their technical problems and collection of factual data for development of new industries, pilot plant trials, (7) food sanitation, survey and advice on hygienic conditions for food industries, (8) food adulteration, development of new methods of detection and quality control, and (9) food information, dissemination of general information on food and dietary problems through bulletins and technological reports.

The work of the Institute will be carried out through the following Divisions Biochemistry and Nutrition, Processing, Storage and Preservation, Quality Control, Microbiology and Sanitation, Engineering, and Information and Statistics A Division of Dietetics and a Section for Food Containers are also being organized

The Institute will soon have a staff of over 200, including 70 scientific workers As the activities develop, additional staff will be recruited The Institute may also have to establish centres and regional laboratories which will work in close association with the Central Laboratory The Institute is now in receipt of a recurring and capital grant aggregating to about Rs 9 lakhs, but this is expected to increase steadily with the opening up of new Divisions and other activities

Microstructure of Gold—Electron Microscope Studies

THE R C A ELECTRON MICROSCOPE RECENTLY installed at the National Physical Laboratory is being employed for metallographic studies This instrument, which has a special accessory arrangement, can be employed to obtain transmission, and reflection diffraction pictures of crystalline materials

Gold is one of the few metals employed in electron microscopy for shadowing to obtain a good contrast in an electron-micrograph The picture on the cover page relates to a few studies on gold films The metal is evaporated under high vacuum (10^{-5} mm) and deposited on a collodion film The first picture (left top) is the transmission diffraction pattern of the gold film, the second (right top) is the reflection diffraction pattern of the same at an angle of 4°, and the third (bottom) is an electron-micrograph of the film surface at a magnification of X 40,000 The gold particles are seen as discrete particles in the electron-micrograph, and the aggregation of particles at some points is due to the contraction of the collodion film as a result of electron bombardment

These studies are important for determining the crystalline nature of a metal surface as well as for determining the inter-atomic distances in metals The reflection diffraction studies are important from the point of view of determining the inner potential of metals and the thermionic work functions of monovalent metals

Fourth World Power Conference, London, July 1950

J W WHITAKER

National Fuel Research Institute, India

THE First World Power Conference was held in London (Wembley) in 1924, the second in Berlin in 1930, the third in Washington D C. in 1936 Meanwhile, a number of sectional meetings of the Conference have been held to consider particular subjects e g Fuels, London, 1928, Power Resources, Tokyo, 1929, Power in Industry & Transport, Scandinavia, 1933, Chemical Engineering, London, 1936, Power in Small Scale Industries, Vienna, 1938, and Fuel Economy, the Hague, 1947

The object of these conferences and sectional meetings is to afford leading engineers, scientists, administrators, and economists from the various countries of the world a meeting ground where they can discuss, for mutual benefit, problems and advances connected with the generation and supply of energy for public utility Potential resources in hydro-electric power, coal, oil, and other fuels are reviewed as well as problems connected with agriculture, irrigation, and general industry Developments in the utilization of atomic energy are also comprised in the review in so far as they are related to the above programme

Fifty-two countries were represented at the Fourth World Power Conference At the opening session on July 11, the delegates were welcomed by Sir Harold Hartley who gave a brief review of the objects of the gathering and of the benefits which could accrue from the deliberations.

The subjects of discussion fell into 10 main sections and 146 papers were presented at the session Notes on some of the leading papers are given below

Energy Resources & Power Developments

About 30 papers were submitted dealing with the energy resources of the different countries of the world Statistics were given showing the fuel and water power used and the estimated assets and probable developments for each country Broadly speaking, it becomes more and more evident that those countries which have truly large supplies of natural energy in the form either of fuel (coal and oil) or of water power are not many In other words, the natural resources of energy are unevenly distributed throughout the world The U S A seems to be particularly favoured, but the resources of Canada, U S S R, U K, and certain European countries are also great Particulars regarding Africa are meagre, and the continent of Asia cannot be said to have been sufficiently explored as yet to permit of a true assessment Australia is now known to have fairly large deposits of coal (brown and black), and the same is true of Canada where the bituminous shales form comparatively unusual types of deposit whose potential value is so far not decided Pakistan would seem to have very limited supplies of fuel, and none of coking coal The paper submitted by the Indian National Committee on the "Assessment of the Energy Resources and Their Development in India" shows India's position to be far better than that of her neighbours

Preparation of Solid Fuels

Coal — In a paper from Great Britain, submitted by the Chief Coal Preparation Engineer, National Coal Board, on "The Problem of Coal Preparation", the author (Grounds) first draws attention to the effects of mechanization on the quality of the coal now produced and to the fact that, while "mechanization made steady progress during the 2nd World War, improvements in coal preparation virtually came to a standstill". In Great Britain, therefore, the National Coal Board was faced with the task of closing a gap The work is urgent because (1) a higher proportion of dirt is now being sent to the surface with the coal, (2) the raw coal contains a greater proportion of small coal (and particularly of fines), and (3) inferior seams are now being worked which contain large quantities of middlings and inter-stratified coal and shale Coal washing has thus become imperative Baum boxes (jig washers) are still the commonest type of washer in the country, and they are useful when coals of easy washing characteristics are to be treated, and/or when a separation at a specific gravity of about 1 5 or higher is required Where appreciable quantities of middlings of specific gravities between 1 4 and 1 7 are present, however, the efficiency of separation decreases, and good separation of clean coal, middlings, and shale cannot be effected, although a crude middling fraction can be produced for crushing and re-washing Usually in Britain the larger *sizes* of coal require to be separated at low specific gravities, and jig washing becomes notably less efficient when attempts are made to use it for separations below a specific gravity of 1 5

Turning to dense-medium processes, Grounds gives a useful and brief review of the development of the washers of Chance, Barvoys, Tromp, Ridley and Scholes, and the American Cynamid Co No mention is made of cyclone washers

Summarizing, Grounds claims that the trend in Great Britain for future large coal-cleaning plant is to have (a) dense-medium washing for the large coal, say 8–1 in, (b) Baum washers for the small coal, say 1 in – ½ mm, and (c) froth flotation for the fines of ½ mm –0 in size

A standard plant of dense-medium *cum* Baum is being developed by the National Coal Board, with standard units also for the new froth-flotation plant Incidentally, the fines are now of greater importance than formerly with mechanization there has been an increase in the proportion of fines, and the quantity now produced (at certain mines) is far too large to be discarded as in the past.

"In their passage through the washing plant, the natural fines become suspended in the wash water, and their quantity is increased by breakage of the raw coal during its passage through the washer and over the de-watering screens In addition, the constant circulation of wash water leads to a still further breakdown, both of fine coal and, particularly, of soft shales The effluent from the washing plant was formerly run into settling bays, where the solid settled out and the clarified water ran into any convenient stream The settled solids were eventually dug out, at the expenditure of much labour, and were sometimes used for boiler firing The *slurry* might contain up to 20 or even 30 per cent ash and about 15 per cent moisture, and was anything but an ideal boiler fuel The hand firing of slurry was arduous work, particularly when it was produced from coking coal, for the slice-bar and poker were in continual use, thus necessitating continual opening of the fire doors and the in-leakage of excess air, with corresponding drop in boiler efficiency The amount of ash to be handled, too, was excessive

"The froth-flotation method of cleaning fines has, however, been adopted for larger quantities and, where coking coals are concerned, the clean fines containing, perhaps, only 9 per cent of ash, can be blended with the washed small coal, since breakage is not of any serious importance

"With industrial coals, however, there is a limit to the percentage of fines which can be blended with the washed smalls or slack, especially if the coal is a non-caking or only slightly caking one There is another possibility, however, namely the drying of the filter cake produced from the froth-floated fines, and the use of the dry, clean fines for pulverized-fuel fired boilers From a dirty, almost unusable fuel a coal can thus be produced containing, say, about 8–12 per cent ash and 2–3 per cent moisture for a cost of, say, *3s 6d to 5s per ton* for froth flotation and another *2s 6d to 3s per ton* for drying This problem of thermal drying will have to receive serious consideration in the near future, as we cannot afford to throw on the dirt heap thousands of tons of very fine coal now produced in the washeries of this country"

The above costs should be noted larger sizes (e g ½") can be washed at about one-fourth of the above rates

The sizes of modern coal washeries are increasing — from a few hundred tons per hour in older plants to over 1,000 tons per hour in recent ones

The general discussion of the papers in this section turned largely on coal-cleaning plants Sir Eric Young of the National Coal Board made a plea for the reduction of capital cost of such plant, which, he said, was now 4 or 5 times higher than the pre-war figure

Lignite, Brown Coal, etc — The paper submitted by F H Roberts on the preparation and utilization of the brown coal of Victoria, Australia, was of outstanding interest The estimated recoverable brown coal reserves in Australia are about 37,000 million tons, whereas there is less than half this quantity, namely 15,000 million tons, of ordinary black coal The brown coal deposits of Victoria are several hundred feet thick — sometimes 800′, covered by about 60′ of overburden They are exploited by the State Electricity Commission and the Victorian Government Mines Department As worked, the brown coal contains about ⅔ of water, i e 66 per cent, but the ash is very low (less than 1 per cent) while sulphur is about 0 1 per cent (on a dry coal basis these figures become respectively 3 per cent and 0 3 per cent) The total carbon in the coal is 22 per cent in the wet coal and 73 per cent in the dry The gross heating value of the coal, on the wet basis, is 3,710 B t u /lb , on the dry basis, 12,400 B t u /lb The ash is variable in composition but usually contains little silica, much iron oxide, magnesia and lime and a fair quantity of sulphates

In spite of its low heating value, this fuel can be burnt in water tube boilers to give a net boiler efficiency of about 70 per cent The coal has been burnt in different ways at different periods of development, e g in step grates using pre-drying shafts, and (more recently) as powdered coal, the grinding being relatively coarse Even the wettest brown coals can be simultaneously pulverized and dried in suitable mills two or three different types of such mill have been employed Generally, however, there has been a certain amount of pre-drying of the fuel The paper is valuable for reference Brown coal briquettes are also produced for outside use German practice has been the guide, both in the combustion and in the briquetting plant Over 6 million tons of the coal are raised per annum, and it is expected that in a few years the amount will increase to about 10 million tons.

Coke — In this section, papers were submitted (a) on the preparation, properties, and utilization of metallurgical coke in Great Britain , (b) on the carbonization of coal in France , (c) on the control of the coking process in Czechoslovakia , and (d) on the improvement of quality of coke in Poland In general there was little of striking importance The Polish paper submitted by B Roga gave a good review, but was largely theoretical

Liquid Fuels

Petroleum Fractions — Among the papers in this section was a valuable contribution from W M Holaday on advances in petroleum refining in United States, and another by Fleming and Tait of Great Britain on the same subject

Holaday points out that the consumption of fuel energy in the form of coal, petroleum and natural gas in the U S A has practically doubled in the past 30 years, and that at the beginning of this period petroleum and gas supplied only 20 per cent of the energy requirements whereas now they provide over 50 per cent In other words, U S consumption of petroleum has grown enormously in the past 3 decades He next considers the refining techniques employed in order to obtain a proper balance among the products to be derived from the crude In the U S A the chief demand is for gasoline this is not necessarily so in the other countries of the world

The paper provides valuable information on thermal cracking, reforming, catalytic cracking, polymerization, alkylation, and isomerization, polyforming and hydroforming Notes are also given on the general treatment of gasoline and on the effects of modern petroleum-refining practice in modifying the quality of the fuel oils produced Regarding future processing techniques in America and Europe, the emphasis for some years is likely to be on improvements in gasoline quality The United States petroleum industry is spending more than 100 million dollars (*c* Rs 50 crores) per annum on research and development work directed largely to this end The following statistics for consumption of petroleum products per head of population are given

Europe (excluding U S S R) — 22 Imperial gal. per head per year

U.S A — 420 Imperial gal. per head per year.

For gasoline these figures are about 6·7 Imperial gal and 175 Imperial gal. respectively Doubtless Europe would probably use far more oil if it were available The contrast with Asia is of course still more marked

Trends in fuel utilization will require the development and application of new refining procedures to raise the anti-knock quality of motor gasolines Possible means to accomplish this are discussed, together with alternative steps which might be taken by motor-car manufacturers to utilize more efficiently the anti-knock quality of the gasolines that can be made with currently available facilities.

In the paper " Recent Developments in Petroleum Processing ", by Fleming and Tait, the oil-refining position is reviewed beginning from 1936, when practically there were only 3 basic processes, distillation, thermal cracking, and thermal reforming Since that time, however, developments have led to a number of other processes But there is an economic limit to the improvement in quality which can be obtained by these processes, a limit arising from the loss in yield and the formation of large quantities of gas (hitherto wasted) This stage is reached when the products from the thermal re-forming units have an octane number of about 73 The new processes comprise the following (1) polymerization, (2) alkylation, (3) isomerization, (4) superfractionation, (5) catalytic cracking, (6) hydroforming — referred to earlier

Diesel & Other Liquid Fuels — In this section W Schroeder and A Fieldner of the Bureau of Mines, U S A , discussed the recent advances in the Unites States in the manufacture of synthetic liquid fuels with particular reference to the work done in their laboratories It is clear that as yet no one process has gained outstanding preference and that investigators in U S A are continuing to explore the possibilities both of hydrogenation of coal (and coal-tar) and of the Fischer Tropsch (hydrocarbon) synthesis with equal interest

A paper submitted on the highly bituminous coal of Portuguese West Africa by the Portuguese representative was heard with interest

Preparation of Gaseous Fuels

Natural Gas — In this section there was a paper from France on natural gas The following is quoted from the résumé

" Natural gas is produced mainly in the south-west of France, where the Saint-Marcet gas field was discovered in 1939, and developed after 1942 The gas is produced from Jurassic dolomites, and the wells have an important open flow capacity After being treated in the Boussens natural gasoline plant, the gas is distributed to the consumers through the most important French pipe line system, 500 miles long The main uses are the following Town gas (new supply or replacement) , furnace and boiler heating , manufacture of fertilizers, motor fuel gas The use of natural gas already represents a yearly saving of 420,000 tons of coal and 82,000 tons of gasoline, propane and butane " The use of bottled gas (butane) is probably capable of much development in India

A paper from the Belgium contributors dealt with the harnessing of fire-damp from the coal mines for use as gaseous fuel

Gas from Solid Fuels — Such gas is obtained largely by coal carbonization or producer practice some of the papers submitted dealt with underground gasification of coal (France) There was a valuable review of modern carbonization problems in Great Britain by G E Foxwell, C Johnson, J Burns, and others In these papers, attention is drawn to the importance of clean coal for carbonization, and to the difficulties which have been caused by using coal containing greater and greater amounts of impurities Burns discusses the adverse effects of poor quality coal upon the results of gas manufacture and deplores the increased ash of modern coal and coke

The French contributors submitted a paper on the use of coke-oven plant for providing industrial gas They conclude that, if the market for the coke is assured, coke-oven plant is best installed near a populous area where there is a market for the gas, both industrial and domestic Calcutta would seem to meet these requirements, provided that the market for the coke is assured Other interesting papers in this section dealt with wood and charcoal producer gas for traction purposes in Sweden (1934-35) and developments in the manufacture of producer gas from British solid fuels

Steam Power

A number of papers submitted to the Conference dealt with developments in steam turbine practice and the present trends in design. The units considered were generally of the order of 100 MW operating with steam at 1,500 lb per sq. in. and at 1,050°F. For the blading of these turbines, austenitic steels of 18 per cent chromium and 8 per cent nickel, stabilized with titanium or columbium, are favoured

F Dollin of *C A Parsons & Co Ltd*, Great Britain, in dealing with design trends, emphasized that, although improved thermal efficiency and increased output are important, a fundamental requirement is reliability Increased pressures and temperatures are natural developments, but the saving in fuel consumption to be expected from these measures is not easy to calculate and has been the subject of several recent technical papers, recorded in the *Proceedings of Institution of Mechanical Engineers* "As a rough indication, however, it may be stated that an increase of 100°F (55°C) in the initial temperature results in a fuel saving of about 3½ per cent, whatever the level of pressure and temperature" It is considered that the steam turbine will maintain its position for many years as a dominant prime-mover in the field of power generation

Internal Combustion Engines

This section was devoted largely to trends in oil engine design and to developments in diesel engines. It is remarkable that design in this field is not yet standardized by any means, and that fresh modifications are continuously coming forward In this section there was an unusually interesting paper by Prof Max Serruys on "Comparative Efficiencies of the Main Types of Internal Combustion Engine", in which he estimated the performance of each type of engine, not only on the score of overall thermal efficiency but also analytically, dealing separately with (1) theoretical thermodynamic efficiency, (2) indicator diagrams, (3) combustion efficiency, (4) mechanical efficiency and (5) a factor of performance dependent upon the fuel used

Gas Turbines & Jet Engines

Active interest is being maintained in this field, not only in industrial and thermal power plant, but also in locomotion whether by rail or on sea or in the air Dr D M Smith in "Land Type Gas Turbines" claims that advances in cycle conditions will lead in the course of time to plant of high thermal efficiency, with regard to coal-burning gas turbines, however, he considers that much development is still necessary for commercial success, but that such turbines will be practicable in the moderate power range W Karrer of Switzerland claims that overall thermal efficiencies of about 40 per cent will in due course be achieved at power stations by means of (supplementary) gas turbines. In American gas turbine practice attention is drawn to railway locomotive applications as well as to prime-powers "The most crucial phase of gas turbine development, it is stated, has already begun in the United States This is the operation in commercial service of a locomotive unit and several stationary units"

In "Power Plant Requirements for Future Aircraft", F M Owner and G S. Hooker of the *Bristol Aeroplane Co* proceed to separate the thermal and propulsive efficiences of the various types of new engines

Water Power

Under this head the resources and location of water power plant, and the design of such stations are dealt with Papers were submitted from Canada, Norway, United States, France, Czechoslovakia, Switzerland and Italy In Norway such power plants are often built into the rock The advantages claimed are (1) More efficient utilization of heads and, under difficult ground conditions, greater possibilities and freedom in the selection of design and site of the plant Losses in head may be considerably reduced. (2) Shorter pipe lines, particularly important for plant with high heads or large pipe dimensions Weight of pipes may be further reduced if lined pressure shafts in rock are used (3) Protection against falling rocks and avalanches (4) In sound and dry rock, construction details, such as columns, girders, walls, foundations (5) Cost of maintenance and repairs, which items are frequently heavy at plants in the open, may be materially reduced (6) The plants may be rendered invulnerable against destruction in case of war

In France there is tendency to consider that the sizes of hydro-electric schemes have reached the limits of economic development, but in the United States the trend is towards larger units, with simplification and improvement in construction methods. "Multi-purpose river development programmes have resulted in projects of tremendous magnitude with large generating units. Load conditions have given an impetus to the creation of head by dams, instead of conduits."

From Italy, Switzerland, Czechoslovakia, and Norway there were technical papers on the Kaplan, Francis and Pelton turbines dealing with their respective fields of application There was also from France an unusually interesting paper on the possibilities of the utilization of differences of temperature between the deep and the surface water of the sea at Abidjan, Ivory Coast, West Africa The surface temperature is 28°C while the cold water at depth is at 8°C, thus giving the necessary thermal potential. The French Government is investigating the possibilities of harnessing this source of energy It is stated that the problem has been solved theoretically and now remains only to be tested Work is going ahead The principle consists in evaporating the warm water at 28°C under vacuum The steam thus generated is inhaled by the condenser which is cooled by the deep cold water On the way the energy of the steam is utilized to drive a turbine and an alternator.

Atomic Energy

Papers on the development of power from nuclear energy were submitted by Sir John Cockroft of Great Britain and by L Kowarsky of France

According to Cockroft, the following are the principal technical problems which will be faced in the course of the nuclear power development programme (a) high temperature operation, (b) high heat transfer rates, (c) neutron economy and breeding, (d) long operating life, (e) development of economic chemical processing, and (f) disposal of radioactive waste

Each of them must be solved if the programme is to succeed

"The building of the first experimental reactors will probably occupy the next three to five years During the following five years we may expect to gain operating experience and be designing the first full scale nuclear power producers At least the same period will probably be needed for the necessary chemical engineering and metallurgical developments required to produce economical processes We are unlikely therefore to embark on any large-scale development of nuclear power before at least the following decade."

Miscellaneous

Wind Power — In an unusual paper on "Recent Developments in Large Scale Wind Power Generation in Great Britain", T G N Haldane and E W Golding analysed the economics of utilizing wind-generated energy in any electricity supply net-work, and gave estimates of generating costs In Great Britain it is only in certain (western coastal) areas where the wind is of sufficient regularity and force to justify the installation of such plant

Another noteworthy contribution to the Conference dealt with a unique hydroelectric project water from the Mediterranean would be admitted to the Qattara depression in the Northern Libyan Desert (which is about 70 kilometers from the coast), the flow of incoming water being balanced by evaporation from the salt lake which would be formed The scheme as now proposed provides for a drop of 50 m below sea level, the area of the lake which would eventually be formed being some 13,500 square kilometers The cost is estimated at £110 million Power output would be 3,00,000 kilowatts, and "it is conceivable that with the creation of a vast salt lake, with fishery prospects, and the possibility of cultivation of thousands of acres around this lake, by means of electric power for lift irrigation from Nile waters, a new and vast area could be added to the cultivable area of Egypt"

A recurring theme throughout the Conference was the growth in the amount of low grade coal now being produced throughout the world There is evidence that in many countries the coal seams of higher grade have been largely worked out and that from year to year the natural quality of the fuel being produced tends to fall due to the excessive amounts of impurities now being worked and wound with the coal Moreover, mechanization itself (owing to the inability of machinery to discriminate) contributes to the production of rather inferior coal Consequently, in many of the papers submitted there was abundant reference to methods of utilization of such fuel and/or to its purification prior to use In a word, increased attention is being given to more efficient methods of treating and using *low grade coal* in the major coal-producing countries of the world.

The Mechanism of Boiling

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IT is relatively within recent years that the mechanism of the formation of a bubble has received attention This is partly because the formation of a bubble is a non-equilibrium process not amenable to thermodynamic treatment In addition, the general prevalence of extraneous bubble nuclei in aerated liquids and on ordinary surfaces, which promote boiling and effervescence, has made the investigation of the problem difficult

Nucleate & Film Boiling

When water is heated on a hot surface whose temperature is gradually raised, a stage is reached when "nucleate" or "bubble" boiling sets in This is followed by " film " boiling The " boiling curve " (FIG 1) qualitatively illustrates the changes that occur The temperature drop, △t (°F), corresponding to the point of inflexion in the curve for flux, which marks the transition between nucleate and film boiling, is called the critical temperature difference

The first boiling curve was given by Nukiyama[1] Farber and Scorah[2], using electrically heated Ni, W and chromel A and C wires, found that different metals give different boiling curves for the same liquid McAdams *et al* [3] obtained data on heat flux in the film boiling range well above the maximum possible in the nucleate range All the variables influencing the shape and the position of the boiling curve are not known but the character of the heating surface seems to be the most significant factor The critical temperature difference has been found to be different for each surface-liquid system[4-8] Between the maximum and the minimum points in the curve for flux, there exists " mixed boiling ", i e nucleate boiling on some parts of the surface and film boiling on the rest

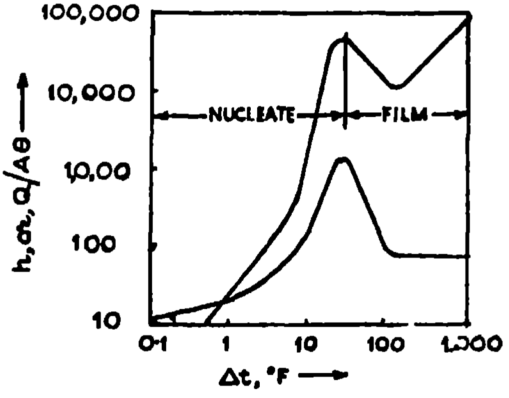

FIG 1 — BOILING CURVE

The insulating action of the vapour layer was first described by Leidenfrost[9] The critical temperature drop for a given surface liquid pair is substantially independent of the boiling temperature and the corresponding flux increases with increase in boiling temperature However, Moscicki and Broder[10], using an electrically heated wire, found the limiting temperature of the surface to be independent of the main body temperature of the liquid.

Surface Boiling

This term is applied to very high rates of heat transfer observed when sub-cooled liquids are heated by surfaces above the boiling point This phenomenon was investigated by Knowles[11] a few years ago McAdams *et al* [12] made further investigations using degassed distilled water Photographic observation showed cyclical formation of bubbles on the surface and subsequent condensation at regular intervals Aeration of water gave higher heat fluxes at a given temperature difference Kreith and Summerfield[13] determined heat transfer for flow of aniline, n-butyl alcohol and water. Fluxes as high as 16,00,000 B Th U /hr /sq ft were obtained These investigators concluded that the addition of a small amount of a volatile component should be helpful in achieving the very high rates characteristic of surface boiling. In these tests, the difference of temperature from the surface to the bulk of the liquid appeared to be one of the correlating variables Gunther and Kreith[14] heated stagnant, sub-cooled water using a small, flat, horizontal, electrically heated strip above the boiling point and obtained pictures at the high heat fluxes. The authors concluded that the high heat transfer rates resulted from the disturbance of the surface film by periodic formation and collapse of bubbles

Mechanism of Nucleate Boiling

Evaporation is a non-equilibrium process since heat and mass are continuously being transferred from the liquid to the vapour phase Because of surface tension, energy is required for the formation of a liquid-vapour interface as well as for extending the surface so formed

Larson[15] derived the following expression connecting " Contact Angle " (FIG 2) with " Work of Adhesion " and " Work of Cohesion "

$$\cos\theta = \left(\frac{2W_{ls}}{W_l} - 1\right) \quad . . \quad (1)$$

where

$W_{ls} = \sigma_{lv} + (\sigma_{sv} - \sigma_{ls})$ = Work of Adhesion, and

$W_l = 2\sigma_{lv}$ = Work of Cohesion,

showing that the contact angle θ depends upon the relative attraction between solid and liquid and between the molecules of the liquid itself Fig 3 shows the various shapes of bubbles depending upon the value of θ.

The surface energy requirement accounts for the fact that the vapour pressure inside the bubble is lower than would normally occur for the same temperature and pressure conditions of the environment Thus

$$p_c = p_s - \frac{2\sigma}{r}\ \frac{\rho'}{\rho' - \rho''} \quad . . \quad (2)$$

where

p_c = saturation pressure at concave surface,
p_s = saturation pressure at plane surface,
σ = surface tension,
r = radius of bubble,
ρ' = density of saturated liquid, and
ρ'' = density of saturated vapour

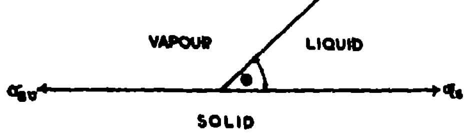

FIG 2 — CONTACT ANGLE (θ) AND ITS RELATION TO " WORK OF ADHESION " AND " WORK OF COHESION "

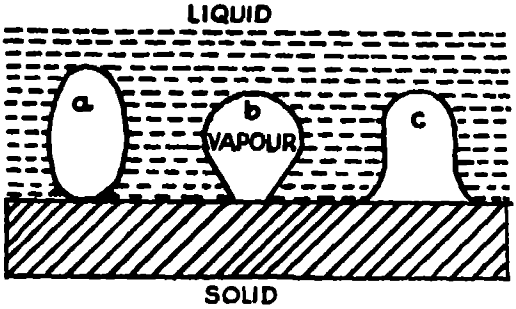

FIG 3 — EFFECT OF INTERFACIAL TENSION ON THE SHAPE OF BUBBLES OF VAPOUR

Also, for a bubble, on account of surface tension,

$$p_{in} = p_{ex} + \frac{2\sigma}{r} \quad . \quad . \quad (3)$$

where

p_{in} and p_{ex} are pressures in the interior and exterior of the bubble

Both the above relationships require the liquid to be superheated in order that bubble formation may start and develop The importance of this superheating was first recognized by Bosnjakovic[16] Since the nucleus bubble is infinitely small, the formation of bubbles according to equations (2) and (3) would require excessive superheating In fact such superheating has been observed with pure liquids[17,18] Actually, however, there are often nuclei present, which facilitate the formation of the initial bubble After " an explosion on a microscopic scale "[19] the bubble comes into existence and superheating provides the motive force to its development

Jakob[19] and his associates have made a detailed study of the formation, rate of rise, and growth of bubbles, and of the distribution of the temperature above the heating surface up to the steam region The temperature changes suddenly at the water surface, the mean superheat in water being 0 3° to 0·5°C In the close proximity of the heating surface, the superheating of water increases greatly up to the temperature of the heating surface, indicating that a thin layer apparently exists not mixed up by convection, similar to the well-known Prandtl boundary layer Surface roughness is found to facilitate heat transfer.

Superheating, Supersaturation & the Role of Ebullators in Bubble Formation

The problem of the effervescence of a liquid supersaturated with gas is strictly analogous to that of bubble formation in superheated liquids or liquids under negative pressure At a given temperature the pressure over a liquid can be reduced so that a tension develops in the liquid[20-24] To avoid these extreme conditions, various solids called ebullators are generally used for obtaining smooth boiling

Larson[15] attempted to explain the rôle of ebullators by correlating the adhesion-free energy ($=\sigma_{sv}-\sigma_{ls}$) of various surface liquid combinations with the ease of bubble formation Attempts at quantitative measurement were unsuccessful Tomlinson[25] also showed that sharp edges and points do not promote bubble formation as commonly held Dorsey[26] pointed out that sharp edges and points that were wetted by water could not act as bubble nuclei Dean[27] and his co-workers confirmed this conclusion whereas Cassel[28] considered surface roughness important

Larson[15] developed a thermodynamic theory of bubble formation which led to the conclusion that the nucleus of a bubble is of molecular dimension and that surface tension may be a property of the molecule This is contrary to the accepted theory of capillarity An attempt was also made to explain the rôle of ebullators with the help of this theory

According to Doring[29] bubbles survive only above a critical size Their number varies sharply with temperature Thus, ether may give 1 bubble/sec at 142°C, showing that at this temperature the liquid is very unstable This agrees with the experiments of Wismer *et al*[18] who found that water saturated with carbon dioxide or oxygen at 14 to 30 atm, when suddenly decompressed to 1 atm, showed no immediate bubble formation, and bubble formation occurred after a few seconds only when the temperature was raised to about 70°C With nitrogen under more than 100 atm, on decompression, bubbles formed only on the surface These experiments strongly support the view that only at very high pressures is the spontaneous formation of bubbles possible

Various attempts have been made to ascertain the maximum temperature to which a pure liquid may be heated without causing it to boil[16,18,20] Eggleton and Kermack[17] have obtained data on the highest temperature and the corresponding vapour pressure maintained for 5 sec with a number of liquids before boiling commenced. Meyer[31] found that the breaking tension of ethyl ether was at least 72 atm Dixon[32] cooled water in a sealed tube but the liquid did not break away from the walls until the pressure inside the tube was −150 atm.

Furth[33] has investigated the empty spaces or "holes" in a liquid and developed a statistical theory according to which a liquid attains a state of complete instability when its temperature is raised The temperature at which this just happens is taken as the maximum temperature of superheating Also, the maximum negative pressure required to cause this instability is regarded as a measure of the tensile strength of the liquid While applying this theory to the phenomenon of the escape of gases from a supersaturated solution, in the form of bubbles, only such cases were considered in which the vapour pressure of the liquid is so low that it can be neglected in comparison with the gas pressure

Hatcher and Sage[34] showed that turbulence reduced supersaturation in hydrocarbon mixtures and suggested that localized regions of low pressure associated with vortices, which are widespread in turbulent motion, are conducive to the formation of small bubbles Dean[27] extended the idea further To explain bubble formation by mechanical shock, turbulent motion and ultrasonic waves, when active nuclei had become inactive, he suggested that free vortex motion is probably always responsible for the bubble formed This interpretation was supported qualitatively by experiments

Cassel[28] developed a mathematical theory of bubble formation and considered elements of surface roughness, called " conical dips " and " conical tips ", as conducive to bubble formation

The author has made some interesting observations[35] on the boiling of liquids at atmospheric and lower pressures, under three different experimental conditions, viz (1) boiling in a flask, (2) boiling on electrically heated platinum wire and (3) boiling of liquids in parallel flow over heated wires.

Experimental

The apparatus (Fig 4) employed in (1) and (2) consisted of a test tube, A, about 4½ in long by ¾ in o d, in which the experimental liquid was heated electrically while surrounded by its own saturated vapours Two leads fused into the tube carried a coil of 0·004 in dia. platinum wire The leads dipped into pools of mercury kept in the curved side-tubes of the neck of a 250 c c round-bottom flask to which a cap with a ground-glass joint and a side-tube were fitted A thick wrought iron lead, passing through a rubber bung fitted to each of the side-tubes, and dipping into the pool of mercury, allowed external electrical connections to be made The cap was connected to a condenser and receiver The pressure in the system was maintained by means of a vacuum pump connected to it through pressure regulating devices The pressure was primarily controlled by manipulating a hand-operated valve and noting the level of mercury in the manometer For a more accurate control, an automatic electrical device described by Cryder and Finalborgo[36] was used (Fig 5) The apparatus, made of glass with mercury in the U-bend, had two platinum leads fused into it Its performance depends upon the response of the air enclosed in one of the limbs which was segregated from the rest of the system by means of a stop-cock, after the desired pressure had been established in the system by controlling the hand valve. Fall or rise of pressure in the system made or broke the electrical circuit, thus admitting air through the nozzle or closing the latter to the atmosphere A large aspirator included in the assembly served as a balancing unit The experimental liquid was also taken in the flask

To obtain the desired pressure in the system, the vacuum pump is started and the stop-cock of the automatic control is opened to let the air in the two limbs communicate with each other The hand-operated valve is then carefully manipulated so that the desired pressure is established The stop-cock is then closed, after which the pressure is automatically maintained and there is no perceptible fluctuation in the level of mercury in the manometer, suggesting that the variation in pressure is less than ±0 1 mm of mercury

A suitable amount of liquid was taken both in the test-tube and the flask, together

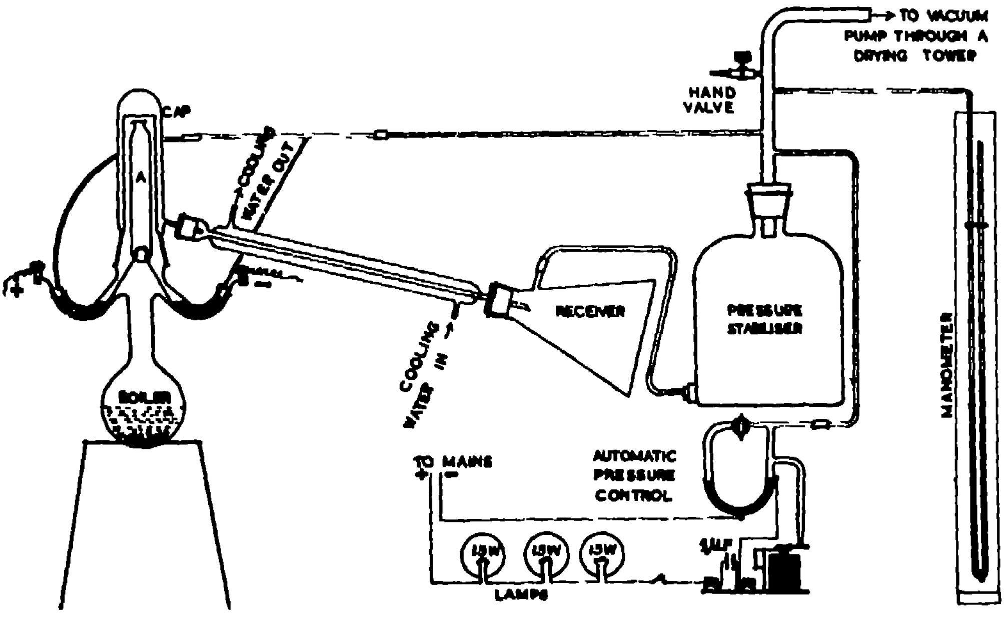

Fig 4 — Apparatus for the study of boiling (1) in a flask and (2) over electrically heated platinum wire

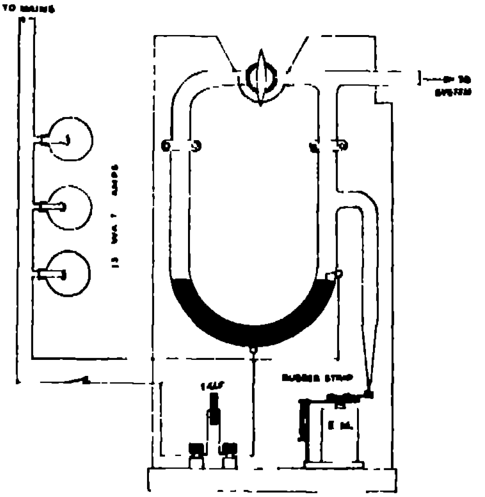

FIG 5 — AUTOMATIC PRESSURE CONTROL DEVICE

with the ebullator under test, the apparatus assembled and the desired pressure established The flask was carefully heated to make the liquid boil When the liquid in the tube A had been heated in the vapour for 15 to 20 min, the current was switched on to obtain boiling in the tube

Boiling in the Flask

It was found that at atmospheric pressures any of the ebullators like porous porcelain, glass-wool and glass-beads was satisfactory for carrying on continued boiling over considerable periods but at lower pressures difficulty was encountered The ebullator was found to lose its effectiveness quite quickly When a fresh charge of ebullator was used, it initiated bubble formation without much difficulty, even at low pressures If the liquid was now allowed to cool without disturbing the pressure and then reheated, serious bumping occurred After a long series of trials it was found that a thick bed of glass-beads, amounting in depth to about half the radius of the flask, could be used with success for steady boiling with the following precautions

(a) The liquid is heated slowly and cautiously and when it is about to boil a little stronger heat is applied to a spot near the edge of the glass-bead bed when bubble formation usually commences and easily spreads to the rest of the liquid

(b) A low flame, with several thicknesses of asbestos paper between the flask and the wire-gauze, is used to heat the entire bottom of the flask This was more satisfactory than a liquid bath

Boiling over Electrically Heated Platinum Wire

When the test-tube was well heated and the vapours from the boiling flask began to distil over, current was switched on through the coil For the experiment to be successful, boiling should commence immediately after switching on the current, continue boiling so long as the current is passing and should stop as soon as it is switched off

The fresh wire gave smooth boiling for a few minutes only When the wire had itself become inactive, various aids like small glass-beads, fine particles of porous porcelain and glass-wool proved ineffective This suggested that it was the condition of the wire surface itself that mattered Its surface was, therefore, coated with finely divided platinum by soaking it in a concentrated solution of platinic chloride and passing enough current to make it glow This was repeated several times to get a good deposit This proved quite satisfactory over considerable periods after which it had to be renewed

Thus, boiling seems to depend upon the presence of agents which aid bubble formation either by supplying nuclei in the form of adsorbed gases or vapours in their surfaces, or by modifying conditions adjacent to the surface In these experiments, the bubble nucleus in the ebullators quickly became inactive in vacuum due most probably to dislodgment of adsorbed gases and vapours However, although a thick bed of glass-beads gave smooth boiling in the flask once bubble formation had been induced, it could not prevent excessive superheating in the test-tube With glass-beads in the flask, it was seen that bubbles originating from the bottom left a trail behind them, this trail served as nucleus for further bubble formation The small cavities formed by the beads seemed to create a suitable condition by modifying convection as well as the manner of escape of bubbles The fine coating on the platinum wire gave good results probably by supplying minute cavities which also acted in a manner similar to the above It seems reasonable to suppose, therefore, that to be effective the cavities must have a curvature comparable with that of the heating surface itself

From the above it is evident that a foreign gas in the liquid, whether in solution or adsorbed on the solid surfaces present in it, gives bubbles much more easily than the liquid vapour itself The origin of a bubble of vapour in a saturated or superheated liquid and that of a bubble of a foreign gas inside the liquid are subject to the same laws of pressure relationships Because of its natural attraction for its own vapour, the liquid would be reluctant to release a bubble of vapour, whereas, if it is assumed that the pressure of the foreign gas increases enormously as the temperature of the liquid is raised, the relatively easy formation of the bubble of the foreign gas inside the liquid could be explained

The rough surface of the platinum wire might also be acting by providing conical " dips " and conical " tips " as postulated by Cassel[28] On the basis of his thermodynamic theory of bubble formation, Larson[15] concluded that surface roughness or curvature of molecular or unit crystal magnitude helps in the formation of the nucleus bubble From Cassel's theory also it could be deduced that the critical size of the nucleus bubble of small diameter could be obtained without excessive superheating only if the contact angle were large and the conical " dip " or the conical " tip " were minute in size, comparable with that of the nucleus bubble Both these theories lead to the conclusion that, for bubble formation without excessive superheating, the elements of surface roughness must be small in magnitude The finely divided platinum easily fulfils this condition This also lends support to the observations of Sauer *et al*[8] who found that a thin film on copper gave a better heat flux than a clean surface

The bubbles formed in the flask were much larger than those formed in the test-tube over the coated platinum wire In the case of simple boiling of water in a beaker, it is usually seen that large steam bubbles leave the surface This would suggest that the size of the initial bubble largely depends upon the curvature of the surface on which the bubble originates A smooth surface with a small curvature gives large bubbles That a rough surface gives smaller bubbles was also noted by Jakob[19] From the point of view of heat transfer, therefore, a rough surface is preferable The formation of smaller bubbles leaves a larger portion of the heat transfer surface to be wetted by the liquid which quickly regains its superheated state

Boiling of Liquids in Parallel Flow over Heated Horizontal Wires

Available literature on the subject shows that boiling on a wire surface is confined to stagnant pools of liquids It was, therefore, decided to study boiling of liquids on horizontal wires with the liquid under forced circulation parallel to the wire Platinum wires of 0 02 in, 0 01 in and 0 005 in dia were used with water and 95 6 per cent (by weight) ethyl alcohol The liquids were circulated at three different velocities, viz 1, 2 and 3 ft /sec Test sections ranged from 6 75 in to 6 84 in in length

Apparatus - The platinum wires were used both as the heat transfer surfaces and as platinum resistance thermometers The apparatus consisted of two main parts (1) the electrical system and (2) the circulating system

The electrical system consisted of arrangements for obtaining regulated current through the experimental wire from a bank of accumulators and for measuring the current strength and potential drop across the test section of the wire The circuit diagram is shown in Fig 6 Current drawn from the accumulators was regulated by a variable resistance Its magnitude was determined by measuring the voltage drop across a semi-standard resistance made from 10 S W G, low-temperature-coefficient-of-resistance "Ferry" wire and calibrated against a precision resistor using a Vernier potentiometer, type 4363, supplied by *Messrs Tinsley & Co*, London, S E 25 Potential drops across the semi-standard and across the

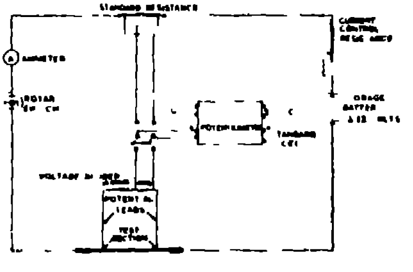

FIG 6 — ELECTRICAL CONNECTIONS EMPLOYED IN THE STUDY OF BOILING OF LIQUIDS OVER HEATED HORIZONTAL WIRES

test section in the actual experiments were measured with a potentiometer capable of measuring 0 01 mv at 1 mv The potentiometer was used in conjunction with a mirror galvanometer Voltages were measured either directly or through a *voltage divider* depending upon their magnitude, the potentiometer being capable of measuring 1 91 volts directly

The circulating system (FIG 7) was assembled from a copper vessel of about 2 3 gal capacity with a reflux condenser, a centrifugal pump, ½ in i d copper tubes, an orifice flowmeter and four valves for controlling the flow The copper vessel was seated on an electric heater inside a steel cylinder and the whole system was insulated against heat loss

A glass U-tube, ½ in i d, with side-tubes, held the experimental wire (FIG 8) and was included in the circulating system by means of short rubber tube connections The platinum wires were C grade supplied by *Messrs Johnson Matthey*, London Their temperature coefficient of resistance was quoted as 0 0035 The method of fixing the wire to its copper leads and mounting it in the glass tube is shown in Fig 8 The potential leads were hammer-welded to the element at about 1½ in. from the inner end of the brass screw holding the element The element was annealed at red-heat in air by passing sufficient current For 0 02 in and 0 01 in dia wires, 0 004 in dia. wire was used as potential lead For the 0 005 in dia. wire the potential lead was only 0 002 in in dia The wire was mounted inside the glass tube by sealing its copper leads to the side-tubes with cold-setting " Marco " Resin No 65C (supplied by *Messrs Scott Bader & Co Ltd*) The potential leads were taken out through side-tubes which were then sealed

Experimental — The flowmeter was first calibrated for water and ethyl alcohol The wire was next calibrated for its resistance at 0°C and at 100°C by passing a nominal current through it and measuring the voltage drop across the semi-standard and across the potential leads of the wire The 0 005 in dia wire was calibrated at the temperature of boiling ethyl alcohol instead of at 100°C This wire was not used with water

The glass tube was mounted on the circulating system, the circulating pump started and the liquid made to boil at a steady, moderate rate The valves were adjusted to give the desired rate of flow For measurements in the nucleate boiling region, a small

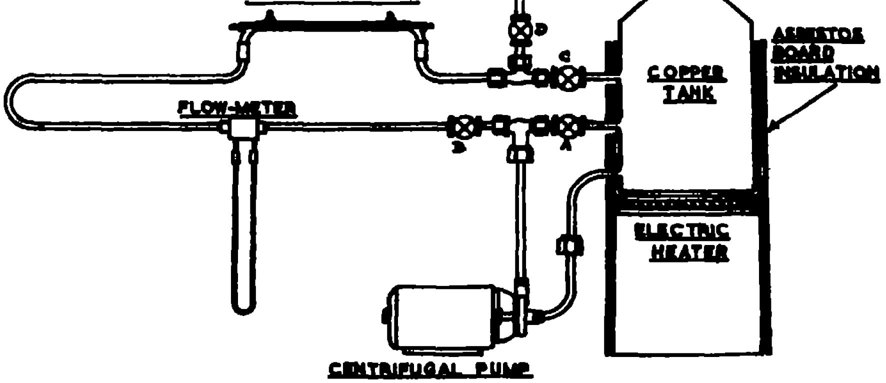

FIG 7 — APPARATUS FOR CIRCULATING BOILING LIQUIDS OVER HEATED WIRE.

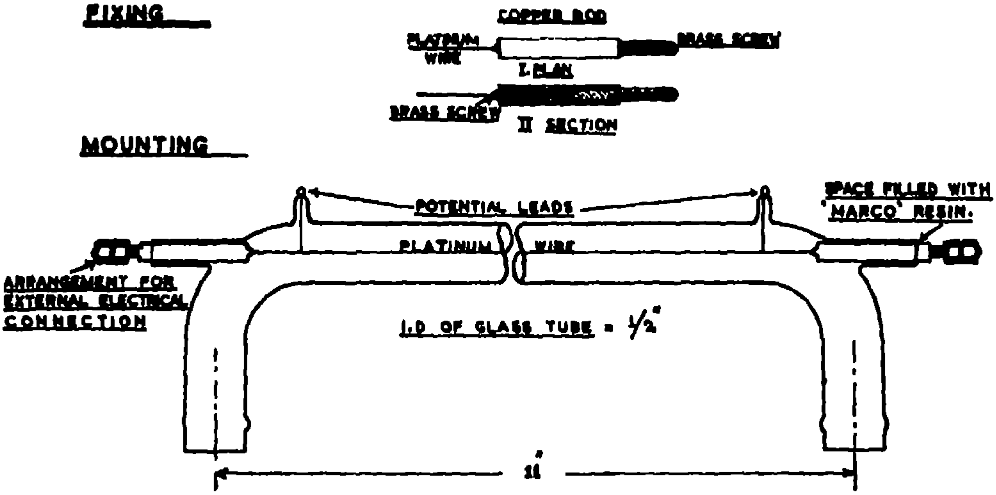

FIG 8 — FIXING AND MOUNTING OF PLATINUM WIRE

D C was now passed through the wire and potential drops were measured across the semi-standard and across the potential leads The current was then increased by small steps to a predetermined maximum and then decreased and a series of current and voltage readings was recorded With each liquid-wire system determinations were made at three different liquid velocities of 1, 2 and 3 ft /sec respectively

Some data were also obtained in the film-boiling region To induce film boiling on the whole wire without causing it to burn out, the following procedure was adopted To begin with, nucleate boiling was induced The current was increased to a high value, the boiling still being of the nucleate type. Without making any further alterations, the current was momentarily switched off On switching the current on again, film boiling set in over most of the wire and quickly spread over the rest of it. Measurements of potential drops were done in the usual way The current was lowered in steps and readings taken at each step When the current strength became small, boiling suddenly reverted to the nucleate type without requiring any special manipulation The measurements were confined to the 0·01 in dia. wire with ethyl alcohol at 2 ft /sec and 3 ft /sec liquid velocities respectively.

Calculations—These were made as follows

(1) Heat load per hour, $q = 3\,415\ EI$, and

(2) area of wire, $A = \pi\ DL$

where

E = voltage drop, volts ,
I = current, amperes ,
D = diameter, feet , and
L = length, feet

(3) Resistance of the wire at temperature, t,

$$R_t = \frac{E}{I}$$

(4) Wire temperatures were computed from the following relation

$$t_p = \frac{R_t - R_o}{R_{100} - R_o} \times 100$$

For the 0 005 in dia wire calibrated at 78 6°C., for instance, the following relation was used

$$t_p = \frac{R_t - R_o}{R_{78\cdot6} - R_o} \times 78\ 6$$

For the 0·02 in dia. wire a radial correction was applied, the surface temperature of the wire was obtained from the following relation

$$t_s = t_p - \frac{(q/A)\ D}{8k}$$

which may be obtained by assuming uniform generation of electric heat in the platinum and constant thermal conductivity. This radial correction amounted to only a few tenths of a per cent in the case of water with the two thinner wires and in the case of all

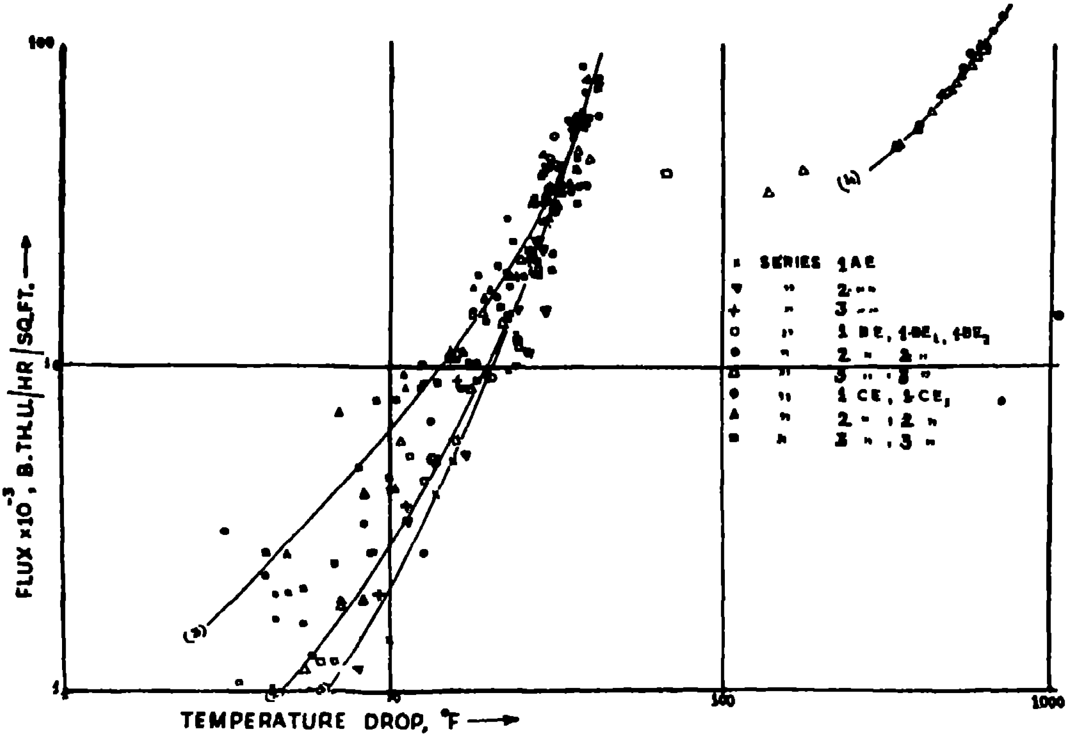

FIG 14 — FLUX VS TEMPERATURE DROP FOR ETHYL ALCOHOL, (1) 0·02 IN DIA WIRE, (2) AND (4), 0·01 IN DIA WIRE, (3), 0 005" DIA WIRE

With any given liquid-wire system, velocity of the liquid parallel to the wire does not seem to have had any considerable effect on the relative positions of the curves for the same liquid (FIG 12 for 0 01 in dia wire) For water with the 0 01 in wire, the curves for the higher velocities have a tendency to be shifted to the left, whereas for ethyl alcohol the effect of velocity, for this same wire, is not appreciable At low and high values of temperature drop, the curves for each liquid have a tendency to merge into one another regardless of velocity Thus for water, the curves appear to merge into one for temperature drop below 5°F. and above 25°F. For ethyl alcohol these limits appear to be 15°F and 25°F respectively.

The results for water and ethyl alcohol, given in Figs 13 and 14 respectively, show that up to a temperature drop of about 25°F the curve corresponding to a smaller diameter of wire is situated more to the left Above this value of temperature drop, however, all the curves for a particular liquid approach one another, regardless of liquid velocity and wire diameter In nucleate boiling range, this merging of the curves for the different wires is very distinct in the case of ethyl alcohol Thus, so far as the effect of wire diameter is concerned, the author's findings agree with those of McAdams *et al* [8]

In the range of film boiling, the points for two different velocities for the same liquid-wire pair lie closely on the same curve Three points for ethyl alcohol lie between the curves for true film boiling and nucleate boiling Their irregular disposition may be due to errors in measurement which were unavoidable considering the irregular boiling that characterizes this region

The nature of the curve in the range of film boiling and for high values of temperature drop in the range of nucleate boiling is the same as generally accepted However, at low values of temperature drop, well within the nucleate range, the curves are somewhat more to the left than those obtained by McAdams *et al.*[3]. These authors found that the flux in this region was of the same order as that for simple heating of fluids by natural convection Obviously, the forced circulation of the liquid in the present investigations markedly raised the flux in this region In agreement with the observations of these authors, the wire diameter seems to have considerable effect on flux for values of temperature drop below about 25°F, the flux rising with decreasing wire diameter For the same wire, the curves for water are situated higher than those for ethyl alcohol

The superheating observed here corresponds to the superheating of liquids in a vertical tube evaporator With the liquid moving at a fast rate, the friction head seems to prevent it from boiling below a certain minimum flux (corresponding to which, therefore, there is a minimum temperature drop) McAdams *et al*[3] observed that at low values of temperature drop, bubbles formed only on the surface of the pool of water and not on the wire In the present case this action might have been augmented by the effect of friction head with the result that the minimum values of temperature drop for the formation of visible bubbles on the surface of the wire ranged from 10°F to 25°F, depending upon the nature of the liquid, its velocity and the diameter of the wire.

Summary

1 Boiling seems to depend upon the presence of ebullators which aid smooth bubble formation either by virtue of gases and vapours adsorbed by them or by creating cavities on the hot surface and thus modifying convection to give local superheating in the immediate neighbourhood of the latter

2. In the case of liquids boiling over heated horizontal wires and moving parallel to them, end effects can be avoided by having potential leads about 1 5 in from each end of the exposed portion of the experimental wire

The form of the boiling curve obtained is the same as generally accepted for stagnant pools of boiling liquids The curve is, however, placed higher in the natural convection and lower nucleate boiling regions

3 Boiling curves for water are placed higher than those for ethyl alcohol, and those for thinner wires are placed higher than the curves for the thicker ones, for temperature drops up to about 25°F

4 Wire contamination shifts the boiling curve to the right

5 Above a temperature drop of about 25°F, velocity of liquid and wire diameter do not have much effect on the position of the curve

6 Minimum values of temperature drop for visible bubble formation range between 10°F and 25°F

Acknowledgements

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Technical Assistance to Industry

The Council of Scientific & Industrial Research has for sometime past had under consideration the question of technical assistance to industry The following are the broad outlines of policy decided upon

(1) The National Laboratories would not, as a matter of policy, undertake routine testing for which facilities exist in the Government Test House, Alipore, and other similar institutions, except when such routine testing forms a part of any survey or investigation being conducted in the laboratories and for testing in connection with issue of certificates of standardization Special tests for which facilities at the existing institutions are not available may be undertaken by national laboratories provided they do not interfere with their normal work The certificate for tests will clearly state that it relates only to the sample submitted and examined

(2) For off-hand technical advice to industry, where no investigations need be undertaken and no written report is necessary, no fees would ordinarily be charged Industry would, however, be required to pay the travelling expenses of the officers concerned

(3) Fees would be charged for technical advice to industry involving minor investigations and submission of a written report, the quantum of such fees being determined by the Directors of laboratories concerned and, if necessary, after consulting the Director, Scientific & Industrial Research In addition to these fees, travelling expenses incurred by officers would be charged to the industrial organization concerned

(4) In the case of major problems involving regular investigations, a scheme of research would be drawn up by the Director of the laboratory concerned in consultation with the Director, Scientific & Industrial Research, and suitable provision made therein for sharing of any royalties arising out of patents, etc, which may be taken out as a result of these investigations Any staff appointed under such schemes will be purely temporary and the salary for the same, as well as incidental charges for chemicals, apparatus, gas, water, etc, will have to be borne by industry.

REVIEWS

Seventy-five Years of Progress in Mineral Industry, Edited by A B Parsons (American Institute of Mining & Metallurgical Engineers), 1947, pp 811

THE SPECTACULAR PROGRESS IN AMERICAN mineral industry during the last 75 years is reviewed in a recent publication by the American Institute of Mining & Metallurgical Engineers The compendium is divided into three parts, the first part dealing with the progress in mineral industry, the second section giving a brief history and evolution of the above Institute, and the third division presenting the proceedings of the Seventy-fifth Anniversary Celebration and World Conference on the Conservation of the Potential Mineral Resources A galaxy of authorities in their respective fields of study like L C Graton, L Eton, F Taggart, F Laist, C D King, Oliver Bowels, Sir Williams Fraser, Augustus Carlow, L C Cates and a host of others have treated a variety of subjects such as mining geology, metal mining, leaching and smelting of ores, ore dressing, non-ferrous metallurgy, ferrous metallurgy, fuels and conservation of mineral resources in an admirably interesting and instructive manner

In mining geology, L C Graton, explaining the origin of metalliferous ores, expounds the intimate relationship existing between geology and mining and traces how the various reputed mining companies in U S A effected a perfect co-operation and co-ordination between the two branches by appointing consulting geologists or instituting a separate department of mining geology to investigate the structural, stratigraphical and theoretical aspects of ore deposition, thereby eliminating guessing in mining enterprise involving substantial private or state funds. Realizing the importance of economic geology to mining, educational institutions have turned their researches towards the investigation of the governing principles of mineral deposition and conditions of ore formation in the various mining districts which furnished them with ample knowledge in the physico-chemical principles of mineral formation in economically profitable quantities This co-operation between academies and industrial concerns paved the path to boom up to the peak figure the production of all strategic minerals to the tune of 9,000 million tons during the period of Second World War

Metal mining has also shown a great progress over the earlier defective methods Writing back from the early times, Lucien Eton has presented the development of accurate surveying and mapping of mine workings, the timely and rational use of explosives to prevent fatal injuries, the various mining methods in vogue, haulage, drainage, stoping, tunnelling, drilling, timbering, ventilation, transportation, etc, and is hopeful of further improvements in the methods and techniques of metal mining with the progress in the dissemination and application of the knowledge of principles of engineering F Taggart, on the other hand, entertains the reader with a wealth of information on the antique and recent processes of ore dressing under separate sub-titles, each section treating all the information in an interesting manner Notable advances over the earlier processes of ore dressing such as milling, comminution, crushing, micronizing, and other related topics are given in a simple and intelligible way so as to enable the reader to understand every step of the process utilized for the beneficiation of the ores A marked advance in this technique is the development of flotation process during the years between 1916-1926 (in which Prof Taggart himself played an important part) from which time flotation machines have been built to serve in practically any set of operating conditions with diverse varieties of flotation reagents. Almost all the ores at the present time are subjected to conventional flotation procedure so as to reduce waste to a practicable minimum Similarly, in the field of gravity concentration, the most revolutionary development since the invention of the shaking table and the application of sink float is the Humphrey's spiral which is also finding a place in coal washing and which may ultimately replace tables in gravity concentration

In the field of non-ferrous metallurgy, the leaching, smelting and purification of copper, zinc, gold, aluminium and magnesium merit special study Starting with the recovery of copper, notably those which are low in impurities from the Lake Superior deposits and containing 3 per cent copper, the magnitude of the operations for the recovery of copper increased enormously since the beginning of the twentieth century as a result of the advances made in the operational techniques to cope with the discovery of new profitable geological horizons bearing copper in other regions With the rate of increase of consumption of non-ferrous metals and their alloys, new techniques and designs have been evolved to increase the load capacity of the furnaces, converters and electrolytic baths to refine them to the desired purity Besides, metals which were unknown or difficult to extract from their ores or are considered as museum curiosities have become of daily use, purchasable at cheaper prices than were prevailing seventy-five years ago Ferrous metallurgy does not lag behind the non-ferrous metallurgy This is amply illustrated by the fact that the production of steel ingots grew rapidly from less than half a million tons in 1870 to 90 million tons in 1946 of which 80 million tons are produced annually in open-hearth furnaces Text figures depicting the improvements in the designs of blast furnaces, reverberatory furnaces and open-hearth furnaces portray clearly the achievements of the iron and steel industry

Keeping pace with the ferrous and non-ferrous metallurgy are the researches in fuel technology — coal and petroleum The replacement of wood charcoal and anthracitic coal in ferrous metallurgy by coke and bituminous coals increased the meagre mining of less than 50 million tons in 1870 to more than 600 million tons annually The need for high-energy fuel for automobile and aircraft navigation during wars necessitated the investigation, development and application of the technique of thermal conversion to purify the crude oil so as to minimize waste and derive maximum energy and a host of ancillary petroleum products The production of crude oil rose steadily from 50 million barrels to more than 1,700 million barrels annually after the Second World War and still the market for petroleum and its products is expanding.

In the field of production of non-metallic minerals such as building materials, ceramic materials, glass-making minerals, abrasives, raw materials for chemical industries, the value of minerals mined rose from 56 million dollars to more than 1,000 million dollars With the rapid advances in construction and structural engineering, the demand for cement and its subsidiary products finds an important place in the world markets Similarly, the shifting of fertilizers from organic to inorganic, the source of potash from sylvite instead of wood ashes, and the recovery of phosphate from phosphate rocks have enlarged the industrial potential of U S A to such an extent as to have a virtual monopoly and domination in the non-metallic mineral products.

The grave situation developing as a consequence of the rapid depletion of the irreplaceable mineral resources of the world in general, and U S A in particular, necessitated the holding of a conference to discuss the problem of conservation of the natural resources and to reduce and/or completely avoid waste in the mining operations The chapters on the international atomic control and the rôle of engineer and technologist in atomic energy are interesting as they furnish a fine example of co-ordination in scientific work in the development of atomic energy.

The volume abounds in factual data and the material presented by the authors is exceptionally good as it brings to light the present-day position and progress in the diverse fields of mineral industry, and the importance of co-ordination in research and technology for the economic development of the country is emphasized throughout The account is stimulating to the industrialists, to the teacher and to the research worker alike

E VENKAYYA

Electronic Valves, Book II & III — Data & Circuits of Receiver & Amplifier Valves (N V. Philips Gloeilampenfabrieken, Eindhoven, Netherlands), pp. 427 (with 532 illustrations) and 220 (with 267 illustrations) respectively, 1949.

THESE TWO BOOKS ARE DEVOTED ENTIRELY to giving comprehensive descriptions of a large number of receiving and amplifying valves as well as full technical data and characteristics of nearly all such valves manufactured by Philips. Details are also furnished on current and voltage regulators, stabilizers, cathode-ray tubes, photocells, etc. Representative circuits of A.C., A.C./D.C. and battery receivers are given as also of gramophone amplifiers. Descriptions of various test gear of Philips design add to the usefulness of these volumes.

Book II includes all the valves and circuits developed by Philips during 1933-39 while Book III covers the period 1940-41.

Those using equipment manufactured by Philips will find these books useful.

N. B. BHATT

Practical Applications of Spectrum Analysis, by Herbert Dingle (Chapman & Hall Ltd., London), 1950, pp. ix + 245. Price 40*s* net.

THIS BOOK HAS BEEN WRITTEN BY AN AUTHOR who has been a close associate of the late Professor A. Fowler at the Imperial College, London, during the years when the foundations of science of line spectra were being laid. In this period, various avenues of applying this branch of spectroscopy to problems of analysis were being explored and the present book forms a record of the author's experiences. It is primarily addressed to readers who would like to possess working knowledge of spectroscopy from the point of view of its applications to analysis.

In order to make the book understandable even to persons not familiar with spectroscopy, an introductory chapter, "General Principles", discussing Bohr's theory, etc., is included. This is followed by a description of "Sources of Luminosity" which deals with the usual methods of exciting spectra. In the succeeding two chapters the principles of taking spectra with prism and grating spectrographs are discussed somewhat in detail.

The above four chapters cover 65 pages, which is nearly half the book. The most instructive chapter is on "Qualitative Spectrum Analysis", pages 74-122, which describes fairly fully the peculiar problems which arise in identifying individual metallic elements, including the rare earths. There is then, only a brief reference to "Quantitative Spectrum Analysis".

The utility of the book is considerably enhanced by eight tables in the appendix which include wavelengths of iron arc lines, raies ultimes and identification lines on plates I-XIX.

W.M.V.

Vegetable Crops, by Homer C. Thompson (McGraw-Hill Book Co. Inc., New York), Fourth Edition, 1949, pp. 611. Price $ 6.00.

THIS WELL-KNOWN BOOK WAS FIRST PUBlished nearly 3 decades ago to serve as a guide to the principles and practice of vegetable culture and marketing, particularly to students of horticulture in the U.S.A. That the book has served its purpose successfully and has enjoyed sufficient popularity with its users is illustrated by the fact that it had already undergone three editions and is now appearing as a fourth edition, in a new and revised form. The last edition was published nearly 10 years back and the opportunity has been well taken to bring the matter fully up to date. As in previous editions the earlier chapters of the book deal with the general outline of the principles and methods of vegetable culture, classification and preparation of soils, use of manures, fertilizers and irrigation, control of weeds, pests and diseases, and problems of storage and marketing, all in a remarkably comprehensive manner. The later chapters of the book, which form the bulk, is devoted to a systematic treatment of the history and taxonomy, culture and harvest, storage and marketing of each one of the leading vegetable crops in the U.S.A. The crops are classified under 12 groups based mainly on their methods of culture, viz. as perennial crops, pot herbs or greens, salad crops, cole crops, root crops, bulbs, potato, sweet potato, beans and peas, solanaceous fruits, cucurbits and miscellaneous crops.

In this edition, the general arrangement of the subject-matter remains practically unaltered, although considerable portions of the book have been revised and in many places rewritten to include all the results of recent researches in the U.S.A. Chief among the new inclusions are statistics regarding *per capita* consumption of vegetables in the U.S.A., recent advances in the knowledge of nutritional value of vegetables, importance of minor and major elements in plant nutrition, weed control by the use of chemicals, control of pests and diseases by new types of insecticides and fungicides and their application by aeroplanes, and advances made in handling and packing of vegetables, particularly the use of transparent films in consumer packaging Mention is also made of the marked development of roadside marketing of produce, coinciding with the great expansion of travel by automobile In the chapters dealing with individual crops, many of the topics have been completely revised and in some places new ones added in order to include all the recent advances in the knowledge of the respective crops The list of literature cited has also been enlarged and includes references right up to 1948

The book is primarily intended for students of horticulture in American universities and its outlook, scope and application are, therefore, purely American Further, it deals mostly with temperate vegetable crops and does not include even such tropical crops like taros and dasheens (*Colocasia esculenta*), yams (*Dioscorea* spp), cassava (*Manihot utilissima*), etc, even though they have been long introduced in America and grown to a certain extent in the southern States of the U S A Unfortunately even the literature cited, though extensive, is confined mostly to American publications and hardly any work outside U S A finds mention, with the result that the usefulness of the book outside U S A is somewhat restricted But, in spite of these limitations, the book is valuable, as it contains a mine of information regarding the underlying principles of vegetable culture, marketing and storage which do not materially differ from what is current in most countries, including India. To Indian students it is particularly useful, since it gives a lucid and comprehensive account of what results can be expected by an application of scientific methods to vegetable culture and marketing It is needless to state that vegetable culture in our country is still primitive and far from scientific and even so our methods of marketing and transport. In recent years our acreage under vegetable crops is reported to have progressively declined and with the increase of population our present output is hardly sufficient to meet the growing demands, especially in the face of serious shortage of foodgrains If a substantial increase in output and use of vegetables in our country is contemplated, a good deal has to be learnt and applied of such scientific advances as have been made in the U S A and other countries, particularly for increasing the yield per acre and successfully marketing and transporting them to consuming centres without undue deterioration and damage The book under review will serve as a useful introduction to such principles and methods

The present edition, like its predecessors, appears under the well-known format of its publishers It contains a number of new illustrations besides the old ones, most of which have been slightly enlarged or improved to show the details more clearly

K R RAMANATHAN

The Science of Chemistry, by Watt & Hatch (McGraw-Hill Book Co Inc, New York), 1949, pp viii + 567 Price $ 4 50

THE BOOK HAS BEEN PRIMARILY WRITTEN as a text-book to meet the requirements of students taking the terminal courses in chemistry, and to serve as a guide to teachers who have to give these courses The authors consider that the aim of these terminal courses is not to prepare students for any further study for becoming potential chemists but to impart to them sufficient knowledge of the fundamental principles of chemistry so that they may have a thorough and proper grasp of the scientific method and also be prepared to conduct laboratory work The book is really a comprehensive text The various chapters cover most of the important properties of matter in solid, liquid, gaseous and colloidal states, deal with radioactivity and atomic energy and give an account of the chemistry of important metals and non-metals The authors have succeeded in giving also a good account of theoretical organic chemistry to biology, medicine, agriculture and industry A novel feature of the book is the inclusion of the chapter on industrial chemical products and processes which describes the various stages in industrial research, such as research stage, pilot-plant stage, plant-scale operations and others

The book has been very well written and is well illustrated Its main feature is the distinctive style of the presentation of the various important chemical topics, which is clearly different from the method adopted by the authors of the usual text-books in chemistry The book deserves a place in all college libraries and is commended for general reading to students of chemistry

M P.

Engineering Economic Analysis, by Clarence E Bullinger (McGraw-Hill Book Co. Inc, New York), 1950, pp xii + 397 Price $ 4 00

THIS BOOK (REVISED EDITION OF THE one issued in 1942) is a very valuable addition to the literature available on engineering economics For engineers and engineering students in India, books of this type have a special significance, because with the advent of freedom, nationals of India assume full responsibility for organizing all production enterprises and services This book, coming as it does from a reputed author, heading the department of industrial engineering of a well-known American university and which has been tried out as a text-book in the same institution, must prove a very valuable addition to engineering libraries in India as well as in technical institutions

The book examines in detail, organized engineering effort to produce goods and services to satisfy human want Engineering effort is divided and analysed as a number of steps arranged in proper sequence from research, invention, planning organization, promotion, design, operational supervision, etc, to the sale of finished product Engineers at every stage of their work are called upon to make decisions requiring the study and analysis of the technical and economic aspects of each of the foregoing steps. The ordinary training in a technical college and engineering works provide the engineer the necessary technical knowledge, but for properly assessing and evaluating the economic aspects special training is necessary. In India we have very little facility to provide for this particular line of training It is in this aspect that the present book is of inestimable value, in as much as it deals thoroughly with the technique of engineering economic analysis.

The subject is discussed in its three essential phases, viz the economic analysis, the financial analysis and the intangible analysis In addition, the book also deals with the inter-relationship of the several analyses as well as long-term and short-term aspects

In any enterprise, either for organizing production of goods or for supplying services, the final and ultimate decision is taken not by the engineers themselves, but by the executive authorities like the members of the board of directors, etc These authorities weigh their decisions and judgements on the materials prepared and presented to them by engineers, influenced, of course, by their own knowledge and experience of current problems as well as by the sum total of current market trends It is of paramount importance that engineers, to whom is assigned the rôle to study facts, methods, operations, costs and standards of efficiency attainable that will warrant the investment and execution of projects and services, equip themselves with the latest knowledge and current practices of engineering economics obtaining in the most advanced countries of the world This book goes a very long way to serve this specific purpose

A VISWANATH

Publications Received

STRUCTURAL CHEMISTRY OF INORGANIC COMPOUNDS, I, by Walter Huckel, Cleaver-Hume Press Ltd, $ 9 00

NEW ATOMS, by Otto Hahn, Cleaver-Hume Press Ltd, 12*s* 6*d*

HANDBOOK ON DESIGNING FOR QUANTITY PRODUCTION (Second Edition), by Herbert Chase, McGraw-Hill Book Co Inc, $ 7 50

RADIO ENGINEERING HANDBOOK, by Keith Henney, Mc-Graw-Hill Book Co Inc, $ 10 00

MAN IS A MICROCOSM, by J A V Butler, Macmillan & Co Ltd, 10*s* 6*d*

PLASTICIZERS, by D N Buttrey, Cleaver-Hume Press Ltd, 18*s*

HIGH-SPEED COMPUTING DEVICES, by W W Stifler, Jr, McGraw-Hill Book Co Inc, $ 6 50

DIRICHLETS PRINCIPLE CONFORMAL MAPPING AND MINIMAL SURFACES, by R Courant, Interscience Publishers Inc

LEHRBUCH DER THEORETISCHEN PHYSIK, by Walter Weizel, Springer-Verlag O H G, Gottingen (Germany)

NOTES & NEWS

Field-emission Electron Microscope

AN INSTRUMENT FAR SIMPLER IN design and operation, the field-emission microscope, has been designed at the Kaiser-Wilhelm Institute, Berlin, and has been successfully employed for the study of structure of molecules. The phthalocyanine molecule which has been studied is 50 times smaller than the smallest molecule so far seen with the standard electron microscope. The above fact points to a new means of investigating physical and chemical phenomena visually and in greater detail than has hitherto been possible. The microscope consists of a tungsten wire with a fine tip mounted inside a thoroughly clean and evacuated glass bulb. The tip of the wire has a very small radius of curvature. The application of a positive voltage to the surface of the bulb produces a field on the surface of the tip of the wire large enough to attract electrons out of the wire tip even when its temperature is lower than that used in the thermionic emitting filaments. The electrons proceed in straight lines until they reach the inner surface of the bulb, which is covered with a phosphor which glows when electrons impinge on it. Certain regions of the surface related to the crystallographic axes emit electrons more easily than others and the electrons moving out in nearly straight lines from these parts of the surface give rise to brighter regions on the bulb. Magnifications of the order of one million times can be obtained and the image brightnesses are quite adequate for visual and photographic work. Resolving power is also high.

Muller has found that if a few phthalocyanine molecules are evaporated on the tungsten point, then they locally increase the electron emission. A pattern of brighter spots is now superimposed upon the original broader pattern due to tungsten above. On closer examination these are seen to consist of four segments each corresponding to a benzene ring and tallying with the structure of the molecule deduced by chemical and X-ray diffraction.

The method has its limitations. While Muller's microscope is a simple inexpensive structure, it cannot be opened to change the specimen as is done in the standard electron microscope. The vacuum conditions are very exacting and the microscope does not work in a demountable vacuum system. The molecules to be studied must be sufficiently stable not to decompose when they are evaporated over to the tungsten point. While the resolution and contrast detailed by Muller are far higher than that which can be attained with the standard electron microscope in the study of chemicals of this kind, the resolution is not sufficient to show the detailed internal structure of the molecules (*Discovery*, 1950, **11**, 274).

New Atomic Particles

THE DISCOVERY OF TWO NEW large meson particles — V-particles — was announced by Prof. Blackett at the annual conference of the British Association for Advancement of Science, held recently at Birmingham. Though the lifetime of the particles has not been estimated, photographs have confirmed that the particles decay spontaneously into charged particles, i.e. the pi-mesons which are familiar in cosmic radiation. One is neutral and decays into two charged particles; the other is positive and decays into a positive and a neutral particle. The masses of the new particles have been estimated to be between 250 and 400 electron masses larger than the sum of the masses of particles into which they decayed (*Chem. Age*, 1950, **63**, 355).

Silver & Platinum Catalysts

SOME OF THE RECENT APPLICATIONS of silver and platinum catalysts in German industry are described (*Chem. Age*, 1950, **63**, 291).

The relatively high cost of industrial catalysts from noble metals is more than offset by their greater efficiency and long service life. The high percentage purity of platinum and silver for catalysts and process equipment has minimized the chances of poisoning of the catalysts by traces of certain materials used in industrial processes. Most high pressure plants now use gauze woven from 10 per cent rhodium-platinum wire arranged in multi-layer catalyst pads of 20 to 30 individual nets. Pure platinum is an effective catalyst over a wider range of conditions than the rhodium-platinum alloys. Most of the modern sulphuric acid plants are supplied with nitrogen oxides by a small oxidation unit with a built-in heat exchanger and fitted with a pad of 4 rectangular platinum gauzes mounted vertically. Platinum is also used extensively as a hydrogenation catalyst in organic synthesis dispersed on pumice or charcoal or used directly in the form of platinum black without a support. In Germany palladium was used for direct hydrogenation of acetylene to ethylene. The process consisted of passing acetylene and an excess of hydrogen and steam over palladium in silica gel at 270°C and ordinary pressure. The consumption of the catalyst amounted to 1 kg of palladium per 1,600 to 1,800 tons of ethylene produced. Palladium also finds limited use as a catalyst for the purification of oxygen and hydrogen and for the removal of residual oxygen from atmospheres required for bright annealing and other operations where complete freedom from oxygen is necessary.

Silver has almost universally replaced copper in the catalytic vapour-phase dehydrogenation of methyl and ethyl alcohols. In most existing installations the catalyst is either a thick pad of many layers of silver gauze or a shallow bed of crystalline silver which is prepared by electrodeposition under conditions regulated to produce hard crystals. In the manufacture of formaldehyde by the *I.G. Farbenindustrie* plants at Ludwigshafen and Leverkusen, methanol is oxidized and dehydrogenated with a granular silver catalyst. The silver catalyst is produced by the electrolysis of a silver nitrate solution containing 3 per cent $AgNO_3$ and 0.1 per cent HNO_3.

Silver is a useful catalyst in the aerial oxidation of ethylene to ethylene glycol avoiding the chlorhydrin stage The silver-on-pumice catalyst is made by impregnating pumice with silver oxide and subsequently reducing this product in a silver-lined reactor, using a nitrogen-hydrogen mixture at 200°C The life of the catalyst is estimated to be one year

Amalgam Metallurgy

AMALGAM METALLURGY HAS RECENTLY been applied to solve some important and complex problems of the metal industry A few selected techniques are reviewed (*Research*, 1950, **3**, 407)

Extraction of Aluminium from " AlFeSi " — The process makes use of the principle of filtration as applied to metallurgy The method first developed in Germany during the war is based on the solubility of aluminium in mercury at high temperatures and on the insolubility of iron and silicon On cooling, aluminium crystallizes out Energy consumption is very low as compared with the usual electrolytic method

Extraction of Metallic Sodium — One of the processes is based on the removal of mercury by distillation and the other by electrolysis in an auxiliary electrolyte of molten salt (which is not used up), the sodium being transferred from the amalgam on to a solid cathode on which it is deposited in molten metallic form In the distillation process, sodium is displaced from the amalgam by metallic calcium which has an even greater affinity for mercury than sodium and, therefore displaces the sodium without mixing with it even at high temperatures Calcium can be easily recovered by distillation of the mercury The anodic transfer electrolysis makes use of a molten electrolyte with the lowest possible melting point, e g sodium bromide, sodium hydroxide Metallic sodium is deposited on an iron wire net cathode and rises to the surface

Amalgam electrolytic process using molten electrolytes may also be applied for the extraction of aluminium

Processing Zinc Alloy Scrap — Regenerated metal obtained from scrap, though cheaper, is of poorer quality than metal obtained from ores Amalgam metallurgy techniques make it possible to obtain zinc in a pure and in a readily usable form, starting from scrap alloy Degreased scrap is dissolved in mercury in the presence of dilute sulphuric acid The aluminium reacts with the water and is finally recovered in the form of pure aluminium sulphate crystals, other alloy metals do not react with the water The iron and copper contained in the alloy are not dissolved in mercury and can be separated from the liquid zinc amalgam by filtration, they are obtained in the form of iron-zinc amalgam and copper-zinc amalgam The former being magnetic, the two can be separated The alloys are obtained in powder form by the distillation of mercury The less reactive accompanying metals such as tin, lead and cadmium are gradually accumulated in the zinc amalgam The zinc is obtained by electrolysis in an acid zinc sulphate solution (which is not used up), the amalgam being the anode The cathodes are of aluminium and the deposited zinc is of 99 99 per cent purity The main features of the cell are the slowly revolving iron discs of 2 m dia half plunged into the amalgam pool and half into the electrolyte Passing through the amalgam, the discs are amalgamated and this gives to the anodic amalgam the vertical position necessitated by the vertical cathodes The energy consumption is about 0 35 kWh per kg zinc, i e about one-ninth of the consumption usually needed for electrolytic zinc

Extraction of Zinc from Purple Zinc Ore — The lyes from the calcination process can be electrolysed after preliminary treatment as a neutral zinc chloride solution, the zinc being transferred as zinc amalgam on to mercury cathodes The cells used are of the chlorine alkali electrolysis process

Extraction of Electrolytic Lead from Low Grade Zinc Ores — The lead chloride solution obtained by treating low grade lead-zinc ore is not electrolysed directly as is done in other methods Instead, it is brought into intimate contact with zinc amalgam when lead replaces zinc in the amalgam which passes into solution The solution from which lead has thus been extracted, passes on to two consecutive electrolytic cells with mercury cathodes, the first serves to replenish the zinc content of the amalgam used for the lead extraction, the second to extract zinc amalgam from which the zinc is then extracted in metallic form in a third cell The lead is also extracted in metallic form from its amalgam by a blocking electrolysis in a fourth cell using a lead salt electrolyte of high purity and high conductivity which is not consumed The phase exchange reaction between lead and zinc is instantaneous if the contact area is made sufficiently large and if the contact zinc is strongly agitated The lead obtained is of electrolytic purity

Extraction of Rare Zinc Satellite Metals Concentration Transforming Process — An aqueous solution of the satellite elements is brought into intimate contact with zinc amalgam prior to the electrolysis proper due to the phase exchange reaction the rare earths displace the zinc from the amalgam and accumulate in it If no atmospheric oxygen or other oxidizing substance which can corrode the amalgam are present in the aqueous solution, the phase exchange occurs stoichiometrically and zinc satellites are obtained in a pure form The disadvantage, however, is that gallium is lost The method can be employed not only for the extraction of zinc satellites such as cadmium, indium and thallium, or of lead satellites such as silver and bismuth, but also for processing of various other exhausted or dilute solutions obtained in mining and metallurgical processes

Continuous Separation of Multi-metallic Mixtures — Alkaline solutions of rotary kiln oxides containing equal parts of lead oxide, tin oxide and zinc oxide are made to circulate inside a revolving drum divided by transverse partitions into many narrow chambers the partitions are so arranged that the solution is forced to change direction at every partition, flowing inwards in one chamber and outwards in the next The other phase is zinc amalgam which is contained in small chambers on the periphery of the drum These amalgam chambers are separated from the inner part of the drum by porous partitions. The amalgam contained in a chamber which is brought to the top by the rotation of the drum percolates through the porous partition, falls through the aqueous solution in the form of minute droplets and collects at the bottom where it percolates again through the porous partition and back into an amalgam chamber The amalgam is introduced at one end of the drum as pure zinc amalgam Part of it is continuously removed near the middle of the drum as pure tin amalgam and the rest is continuously removed at the far end as pure lead amalgam , these two amalgams are then processed separately for the extraction of tin and lead The original plumbite-stannite-zincate solution introduced into the drum leaves it at the far end as a pure zincate solution which can be electrolysed to obtain zinc amalgam.

Manufacture of Pure Manganese Alloys — The amalgam metallurgical process producing pure manganese alloys in powder form is by indirect electrolysis in which a sodium amalgam is used for a phase exchange with an aqueous multi-metal saline solution containing all the components of the desired manganese alloy The alloy is precipitated from the amalgam circuit The mercury is removed by distillation in an oven This method of mixing alloy components in aqueous metal saline solutions is useful for low grade ores and eliminates all intermediary stages of the usual manufacturing processes

The exceptional efficiency of the amalgam metallurgical processes and quality premium it brings in, make it possible to counter-balance the higher capital costs of low grade ore exploitation The equipment and functioning of an amalgam metallurgical factory do not depend on the particular alloy produced Different low grade ores can be worked in the same plant

Rapid Determination of Uranium

A RAPID METHOD OF DETERMINING uranium is described The method depends on measuring the intensity of yellowish-red colour produced when a uranyl salt is treated with hydrogen peroxide in the presence of excess sodium carbonate (*Industr Chemist*, 1950, **26**, 375) Molybdenum and tungsten in small amounts do not interfere, but large amounts must be separated as they give a faint yellow colour

Aluminium and uranium are separated together by double precipitation with ammonia , the solution of these elements is then treated with dry hydrochloric acid gas and aluminium is precipitated as $AlCl_3$ $6H_2O$ Uranium is determined in the filtrate , small amounts of aluminium do not interfere Iron is separated by hydrogen peroxide-sodium carbonate precipitation , copper is also carried down in this treatment but traces left in solution do not interfere Cobalt, nickel and cerium are also removed with iron Fluorides do not interfere up to 10 mg per 100 c c but with high concentrations slight bleaching of the colour results , phosphates do not interfere up to 140 mg per 100 c c or silicates up to 60 mg per 100 c c but chromium and vanadium do interfere Chromium is separated by precipitating uranium with ammonia, the chromium being in the form of chromate, while vanadium is determined by suitable means and allowance made for it in the final measurement of uranium

The colour reaction conforms with the Beer-Lambert law and the method can be applied to amounts of uranium varying from 0 2 to 85 per cent of U_3O_8 the average error not exceeding 2 or 3 parts in 100

Nitrate Determination

A MODIFIED BRUCINE METHOD FOR the determination of small amounts of nitrate in biological material is described (*Can J Res* , 1950, **28**, 280)

The reagents used are (1) brucine reagent consisting of 10 gm of brucine dissolved in 80 c c of 95 per cent ethanol, 3 c c of distilled water made to 100 c c with 95 per cent ethanol , (2) concentrated sulphuric acid, reagent grade, free from nitrates (3) sulphuric acid (1*N*) and (4) urea, 10 per cent solution

10 c c aliquot of the solution to be analysed containing 50 to 250 μgm of sodium nitrate are placed in a 50 c c volumetric flask, 2 or 3 drops of 1*N* sulphuric acid and 1 c c of urea solution are added, the mixture boiled for 5 min On cooling 1 c c of brucine reagent followed by 20 c c of concentrated sulphuric acid is added and thoroughly mixed On further cooling in a cold water bath for 20 min another 20 c c of concentrated sulphuric acid are added and contents mixed thoroughly Blanks are run with a second aliquot of the sample and with distilled water The light transmittance of the sample is measured in a photoelectric colorimeter and the nitrate content determined by reference to a previously prepared standard curve

Sugar Analysis

THE AMMONIACAL SILVER NITRATE spray used for the detection of sugar on paper chromatograms involves careful control of the heating step, requiring special apparatus A modified procedure based on a test given by Feigl for reducing sugars, which eliminates the heating step is described (*Nature*, 1950, **166** 444) The method has proved reliable and easy to handle

The dried, developed paper chromatogram strip is first passed rapidly through a reagent solution, prepared by diluting 0·1 c c of saturated aqueous silver nitrate solution to 20 c c with acetone, and adding water dropwise, with shaking, until the silver nitrate which separates on addition of acetone has dissolved Spreading of the spots is limited on account of the sparing solubility of sugars in acetone (0 014 per cent at 23°C for crystalline glucose) The dry paper is sprayed with a 0 5*N* solution of sodium hydroxide in aqueous ethanol, made by diluting saturated aqueous sodium hydroxide solution with ethanol Brown silver oxide is immediately produced the colour facilitating even spraying Reducing sugars form dense black spots of silver more or less rapidly at room temperature When reduction is complete, excess silver oxide is dissolved by immersing the strip for a few minutes in 6*N* ammonium hydroxide, after which the paper is washed for at least 1 hr in running water, and dried in an oven Black or dark-brown spots on a white background are obtained, except when phenol has been used as the developing agent, when the background is greyish The spots can be rendered jet black by momentary exposure to hydrogen sulphide A feature of the method is that substances other than reducing sugars are detected Thus glycerol reacts at room temperature after a much longer period of contact with the reagent than is required for reducing sugars Under the same conditions, trehalose reacts faintly , but the spot can be intensified by heating

A similar technique for the detection of sugars has been employed, using triphenyltetrazolium chloride which, in alkaline solution, is reduced to the insoluble intensely red formazan compound This property has been used in the analysis of reducing sugars A 0 5 per cent solution of triphenyltetrazolium chloride in chloroform is applied as above and after evaporating the solvent at room temperature the strip is sprayed with an alcoholic solution of sodium hydroxide After standing overnight reducing sugars develop intense red spots against a pink background fructose and xylose reacting readily The excess reagent is easily removed by washing with water If rapid reaction is required the strip may be heated for 5 min at 100°C in an oven in a moist atmosphere Non reducing disaccharides do not react

Determination of Free Carbon in Rubber

A SIMPLE AND RAPID METHOD FOR the determination of free carbon in vulcanized rubber stocks is described (*Anal Chem* 1950 **22** 1002) The method is sufficiently accurate for control purposes and has been successfully applied to the analysis of natural rubber GR S Butyl rubber and neoprene

The method makes use of the fact that rubber containing ethylenic double bonds is oxidatively cleaved by *tert* butylhydroperoxide in the presence of osmium tetroxide The sample is softened in gently boiling *p* dichlorobenzene and then treated with *tert* butyl hydroperoxide in the presence of osmium tetroxide catalyst The mixture is filtered through a Gooch crucible The carbon on the filter is washed with benzene and then with dilute nitric acid and water to dissolve inorganic fillers The filter is dried at 350°C cooled and weighed The carbon is burnt off at low red heat and the crucible is cooled and reweighed The loss in weight represents the amount of carbon originally present No empirical correction is required and no difficulties are encountered in the filtration of carbon black

Micro-analysis of Gas Mixtures

AN APPARATUS FOR THE MICRO analysis of gas mixtures containing (i) carbon monoxide and an inert gas or nitrogen and (ii) oxygen and an inert gas or nitrogen is described (*J Sci Instrum* 1950 **27**, **224**) The apparatus has been used for analysing samples of the order of 10 mm at N T P with an accuracy of 1 per cent

A MacLeod gauge with two capillary inlets of 1 50 mm bore tubing for the introduction of the sample and oxygen and a platinum filament just above the bulb comprise the apparatus The volume of the bulb is about 200 c c and that of the combustion tube about 3 c c An important feature of the apparatus is that the mercury in the analyser need never come into contact with tap grease nor with the less pure mercury from the burette and sampler

The mixture for analysis is expanded from the sampler into the bulb the mercury raised into the closed capillary and the pressure and relative volume of the sample measured using a cathetometer The mercury is lowered to its former level a small excess of oxygen expanded from the burette into the bulb the mercury raised and the pressure and volume again recorded To effect combustion of carbon monoxide the level of mercury is again lowered to the desired level and the mercury adhering to the filament volatilized off The gas is then compressed by raising the mercury level and the filament flashed for 10 sec at red heat Finally the mercury is raised into the closed capillary and the resultant pressure and volume measured

Mixtures containing oxygen and an inert gas or nitrogen may be analysed by reversing the procedure i e by adding a small excess of CO to the sample to be analysed The oxidation of mercury is eliminated because CO is in excess

Magnetic Stirrers

EFFICIENT MINIATURE MAGNETIC stirrers have been designed for carrying out potentiometric titrations and conductometric experiments Three models were exhibited at the recent annual general meeting of the Microchemistry Group of the Society of Public Analysts & Analytical Chemists held in London (*Chem Age* 1950 **63**, 296)

The general purpose bench model is 5" long 3½" wide and 3½" high The top or titration platform is of white Perspex 1/16" thick and a ½" thick panel of the same material carries the switch and speed controller The connecting leads are detachable an accumulator or other external battery being used only when long runs are required For ordinary work energy is drawn from an internal flash lamp battery Small but powerful type M 4776A magnets in the form of short slotted cylinders with central holes are mounted directly upon the motor spindle The light weight and small height greatly contribute to freedom from vibration and long life of the motor The assembly spins freely and the poles of the magnet describe a circle in a plane parallel to the Perspex top A variable resistor (maximum resistance 10 ohms) mounted adjacent to an on off switch controls the speed Operation at low speeds gives excellent stirring minimizes current consumption and enables long runs to be undertaken without overheating the motor The stirring action is vigorous at the bottom of the liquid and splashing is avoided even at high speeds Using small beakers or conical flasks it is possible to perform conductometric titration of samples less than 1 c c If required as in Karl Fischer method of moisture determination the titration vessel can be hermetically sealed and stirring continued

Another model is designed for use on a retort stand The cylindrical body slides freely into a retort ring of suitable size and the whole unit is firmly secured by four small Terry spring clips A third low built stirrer consists of a pair of 2½" dia bakelite caps placed mouth to mouth Controlling resistor and motor assembly are retained in position by partially imbedding in sealing wax

Liquid Level Gauge

A DEPTH GAUGE OPERATED BY A continuous air purge for measuring the liquid head in a vessel is described (*J Sci Instrum* 1950, **27**, 223) The instrument is operated by passing a steady flow of air through a variable orifice the variation being effected by a change of level of a liquid air interface so that a small change in level produces a large percentage variation in effective orifice area These changes produce changes in the differential pressure across the orifice The static pressure in the system is then a measure of the head of the liquid in a vessel

A supply of compressed air passes down a dip pipe of the open-ended type, with an inverted V notch cut in the bottom This is surrounded by a second open-ended pipe, cut square, and extending a short distance below it, but clear of the bottom vessel In operation, the interface between the air in the pipe assembly and the liquid contents of the vessel partially seals the V-notch The air passes through the triangular orifice bounded by the notch and the interface and up through the outer tube It then enters a chamber of a relay assembly and passes through a needle valve to atmosphere or into the vapour space above the vessel contents The needle may be sized to have an orifice equivalent to $\frac{1}{8}$" when in the fully open position This is equivalent to a minimum measurable depth of vessel content of 1" when the purge rate is 15 cu ft per hr of free air If the available ratio of areas of the valve is 12 1, the instrument will measure up to a total vessel content of 12' head of water with an accuracy of ± 1 per cent

Uranium Oxide Films

A MODIFICATION OF THE PYRIDINE method for depositing uniformly thin films of uranium oxide used for investigations into the nuclear properties of uranium is described (*J Sci Instrum*, 1950, **27**, 230)

The method was originally used to prepare layers of 1 to 10 sq cm area but by slight variations uniform films covering an area of 100 sq cm can be made Normally platinum foil is used and is washed with nitric acid and distilled water, followed by ignition

The area to be covered is defined by painting the perimeter with a solution of nitrocellulose in ether-alcohol or in acetone For films of small area (1 to 10 sq cm), a concentration of 10 mg of uranyl nitrate per 1 c c of pyridine is used, for films of larger area (100 sq cm), a solution consisting of 500 mg uranyl nitrate and 1 c c of concentrated nitric acid (sp gr 1 42) made up to 250 c c with reagent grade pyridine has been found satisfactory To prepare a film up to 10 sq cm in area, the platinum foil is cleaned and ignited to constant weight The pyridine solution is applied at the rate of 0·02 to 0·05 c c per sq cm by means of a capillary pipette and allowed to evaporate The foil is gently heated to drive off residual pyridine and to destroy the nitrocellulose boundary and then heated strongly to bright red heat to convert uranium salts to oxides On cooling the whole procedure is repeated until a film of required thickness is obtained For a film covering an area between 10 and 100 sq cm the solution is applied at 0·02 c c per sq cm and the area is wetted by rocking the foil gently on a glass plate, the motion being continued during evaporation of the solvent so as to keep the boundary edges wet The crystalline film is allowed to stand for 10 min, then gentle heat from a Bunsen flame is applied rapidly and evenly and continued more strongly and finally to a bright red heat for a few minutes Films of a thickness of 0 3 mg per sq cm have been prepared by repeating the procedure

The technique would not be suitable for thorium and highly α-active uranium preparations because of radioactive dust hazards

Sulphate-reducing Bacteria

INVESTIGATIONS ON THE COMMERCIAL production of sulphur from sulphates employing micro-organisms are in progress at the Chemical Research Laboratory of the D S I R London

About 100 tons of sulphur is formed by bacterial activity each year in certain lakes in North African deserts for every half a million gallons of lake water The bacteria swarming in the waters convert sulphates to sulphides which is reduced to finely divided sulphur by other micro-organisms Experiments are in progress to see whether natural waters rich in sulphates such as waste from sewage works might be utilized and whether bacteria could be made to multiply on relatively large surfaces provided by lumps of coke or asbestos Attempts are being made to obtain highly active strains of bacteria. Cultures of sulphur bacteria procured from the North African lakes and from other parts of the world are being investigated and their growth rate on various kinds of nutrients is being studied

The most promising types of organisms are the purple and green sulphur bacteria, photosynthetic bacteria, which abound in nature and sometimes proliferate in enormous numbers For maximum development they require hydrogen sulphide, aerobic or anaerobic conditions and sunlight All these requirements are satisfied in polluted pools and it might be possible to create such conditions that hydrogen sulphide produced by the sulphate reducers is consumed as it is produced

Another aspect of the problem investigated at the laboratory relates to the method of controlling the growth of sulphate-reducing bacteria The addition of acid to the water decreases their numbers enormously

Black Rootrot in Tobacco

STUDIES ON THE BLACK ROOTROT fungus *Thielaviopsis basicola* (Berk and Br) Ferraris undertaken to elucidate the complex relationships between host, parasite and the soil environment are reported (*Canad J Res*, 1950, **28**, 445)

The fungus exists in two distinct forms, grey and brown wild types. The wild types do not remain stable on media which support abundant saprophytic growth but give rise to and are crowded out or replaced by mutants The wild type can be maintained with a minimum of variation in soil, soil agar or roots

The brown wild type of fungus is usually the predominant form The grey wild type is less pathogenic and is more poorly adapted than the brown to withstand long dormant periods The latter mutates to the grey in the soil host and in artificial culture whereas the grey wild type mutates to the brown only in association with host and not in culture, thereby suggesting a directive influence being exerted by the host parasite relationship Root invasion by *Thielavia basicola* was common only in association with another fungus *Thielaviopsis basicola*, which suggests a commensal relationship between the two fungi

New Insecticide

PRELIMINARY INVESTIGATIONS ON the insecticidal and miticidal potentialities of antimycin A (the crystalline antibiotic isolated from cultures of an unidentified species of Streptomyces) are described (*Science*, 1950, **112**, 172)

The antibiotic caused mortality to insects which ingested the material rather than by contact action of the substance on the exo-skeleton The common housefly *Musca domestica L*, sprayed with 10 p p m of antimycin A showed no adverse effects whereas 38 per cent of the flies allowed to feed on a ball on absorbent cotton saturated with 10 p p m of antimycin A dispersed in water were killed in 24 hr Similar results were obtained with the large milk weed bug *Oncopeltus fasciatus* (Dall) To determine the specificity of action the standard test wool fabric was immersed in a water dispersion containing 10 p p m antimycin A and offered to larvae of the webbing clothes moth *Tineola bisselliella* (Hum) and the black carpet beetle *Attagenus piceus* (Oliv) The larvae of the webbing clothes moth ate the test swathes with impunity while duplicate test pieces inhibited the feeding of the black carpet beetle Further tests were conducted with this beetle comparing antimycin A with sodium aluminium silicofluoride which is a widely used fabric protection against insects The standard wool fabric was immersed and saturated with test subjects aired dried and tested in accordance with the method set forth by ASTM Data showed that antimycin A will afford the same degree of fabric protection at 1/100th the concentration of sodium aluminium silicofluoride compared with methoxychlor (1 1 1 trichloro 2 2 bis (*p* methoxy phenyl) ethane) which is at present used for the control of second instar Mexican bean beetle larvae antimycin A used at the rate of 25 p p m was as toxic as 500 p p m of methoxychlor

Antimycin A is also efficacious for the control of red spidermite *Tetranychus* sp On the basis of LD_{50} readings it is three or four times more effective than DMC (di *p* chlorophenyl) methyl carbinol

Paper from Hemp Waste

PRELIMINARY INVESTIGATIONS ON the suitability of Manila hemp fibre obtained from the leaf stalks of *Musa textilis* Nee are reported (*Philippine J Sc* 1950 78, 355) The fibre is available in large quantities as a rope factory waste in the Philippines

2 lb fibre (moisture free) was digested with cooking liquor the ratio of the volume of the cooking solution to the moisture free weight of the fibrous material was 7 to 1 The digesters were rotated throughout the cooking period at 1 r p m Pulping abaca waste for 2 hr at a maximum temperature of 150°C with 12 to 16 per cent caustic soda on the weight of the raw material gave satisfactory pulps of good bursting tearing folding and tensile strengths The colour of the unbleached pulps obtained under these conditions has a brightness of 22 to 29 per cent

The rate of hydration of soda pulp from abaca waste is relatively fast The pulp is sufficiently hydrated in 20 min to give a Schopper Riegler freeness within the range of 550 to 700 c c and an average bursting strength of 1 33 points per lb per ream The lightest coloured pulp had a brightness of 36 4 per cent The colour of most of the pulps was similar to that of kraft pulps made from wood

New Road Surfacing

THE ADDITION OF 5 PER CENT OF *Mealorub* — flocculated natural rubber latex — to the aggregate mix has been found to considerably improve road surfaces and to make them skid proof Several strips of *Mealorub* surfacing laid before the war and subjected to heavy military traffic emerged after seven years with the quality of an average B road whereas the non rubber road surfaces were worn off completely The June 1950 issue of *Rubber Developments* is devoted entirely to the subject of rubber in road surfacing

Efficient Production & Utilization of Steam

FACTORS AFFECTING THE EFFICIENT production and utilization of steam and the importance of boiler testing fuel analysis treatment of boiler feed water and cooling water for condensers are discussed in an informative pamphlet published by the Shri Ram Institute for Industrial Research (*Efficient Production of Steam* by R S Dubey) The publication contains valuable practical aids and hints on boiler maintenance

Modern trend in the efficient utilization of steam is to employ compact high pressure boilers generating superheated steam Most of the new British boilers are designed for two standard conditions 600 lb per sq in 850°F and 900 lb per sq in 900°F In America boilers are run on steam pressures as high as 1 800 and 2 000 lb per sq in and many are designed for steam production at 1 050°F These new developments make possible the use of power cycles of higher thermodynamic efficiencies

India s coal resources being meagre the need for efficient utilization of coal is of great importance Mining transport storage and utilization of coal are also important considerations while selecting a boiler plant attention has to be given to the pressure required the fuel available the space requirement of the boiler the disposition of the plant the maintenance resources of the factory and the purpose for which steam is to be used Modern methods of cleaning the boiler plant like soot blowing water lancing steam soaking or spray soaking minimize draught loss and give increased heat transfer

The pamphlet is available from the Director Shri Ram Institute for Industrial Research University Road Delhi

Marketing of Mustard & Rapeseed in India

VARIOUS ASPECTS OF PRODUCTION and marketing *sarson* (colza) *toria* (rapeseed) *rai* (mustard) and *taramira* (*Eruca sativa*) are dealt with in a report issued by the Agricultural Marketing Adviser to the Government of India (*Report on the Marketing of Rapeseed & Mustard in India* 1950 Manager of Publications Delhi price Rs 2 or 3*s*) The main botanical species of these seeds commonly grown in India are *Brassica campestris* var *sarson Brassica campestris* var toria and *Brassica juncea* corresponding to colza rapeseed and mustard respectively The commercial seeds are however a mixture of varying proportions of *sarson* rapeseed and mustard Besides two other species viz *Brassica juncea* var *rugosa* and *Brassica nigra* are also found to a limited extent and are generally known as *pahadi rai* and *benarsi* or *asli rai* respectively

Next to China India is the world s largest producer of rapeseed Exports to U K and continental countries amounted to 23 per cent of the entire produce before World War I but have been steadily declining (the present figure being 3 per cent of the production) due to fall in demand from the importing countries and simultaneous increase in requirements in India where the oil is primarily used for edible purposes

The total area under rapeseed and mustard in undivided India (1943 44) was about 58 lakh acres yielding about 11 lakh tons of the seed of which U P accounted for 44 per cent Bengal 16 per cent Bihar 12 per cent Punjab 12 per cent Assam 6 per cent and Sind N W F P and Central Provinces 5 per cent The post partition figures are not included The average yield per acre is about 377 lb as against 557 lb in China 1 000 lb in Japan 1 600 lb in Germany 939 lb in France 830 lb in Poland and 803 lb in Russia Steps to investigate the cause of low yields in India and to develop high yielding strains are recommended The report has outlined a scheme for regulating the production of different types of oil seeds in the *Brassica* group in compact areas on the lines of cotton cultivation and standardized classification and grading This would also avoid confusion in the use of botanical and local names to the various types of rapeseed and mustard grown in the country result in uniformity of production types and reduce heterogeneous number of varieties and trade descriptions Commercial grading of these varieties could be possible on the basis of (1) number of seeds per gm (bold medium and small) (2) oil content (3) correlation between size of seed and oil content (4) moisture content (5) percentage of mixtures of other whole seeds and (6) percentage of impurities and non *Brassica* seeds This would also lead to a more uniform price structure and avoid appreciable variations in prices due to differences in their qualities In Okara (Punjab) during the six seasons (1934 to 1939) a variation 4 7 to 27 8 per cent between the prices of different lots varying in quality sold on the same day was recorded

The prices of rapeseed and mustard in India have been on the increase since 1933 34 rising from Rs 3 10 0 in 1933 34 to about Rs 16 0 per md in 1944 45 The world prices (at London) for the corresponding period were £ 9 per ton and £ 39 8*s* per ton respectively

Institute of Animal Genetics & Nutrition

THE FOUNDATION STONE OF THE Mangalal Goenka Institute of Animal Genetics & Nutrition was laid in October by the Hon ble Dr Rajendra Prasad President of the Indian Union At Anand

Speaking on the occasion Shri K M Munshi Food and Agriculture Minister Government of India stressed the need for the application of scientific and technical resources for the improvement of animal nutrition and genetics

The Institute which was started with the generous donations of Seth Mangalal and other Government and private support now has a farm a dairy a school and a college of agriculture with hostels a postgraduate department of animal husbandry and genetics The Central Government has leased its dairy building and equipment to the Institute and the Indian Council of Agricultural Research proposes to utilize the Institute for a tobacco research centre

The Institute has three sub stations (a) animal genetics animal nutrition and dairy science section at Anand (b) animal breeding farm at Chharodi and (c) animal breeding farm at Surat The research work that is being carried out at the Institute has been mainly confined to metabolic studies on cows and buffaloes fed on different rations

A 5 year scheme for the establishment of a Regional Sub station for Animal Nutrition submitted by the Institute has been accepted by the Indian Council of Agricultural Research Work is already in progress at the Institute on artificial insemination of cattle to improve their milk yields under a scheme sanctioned by the Bombay Government

The Institute has been recognized by the Bombay University for training in postgraduate studies in animal husbandry and dairying animal nutrition and dairy science, and plant breeding and agronomy

Indian Standards

Radio Components — A DETAILED Indian Standard Specification for Fixed Paper — Dielectric Capacitors has been drawn up by the Sectional Committee of the Indian Standards Institution prescribing requirements for material workmanship and marking besides other mechanical tests Comments on the draft (copies can be had on application) should reach the Director Indian Standards Institution University Road Delhi by January 10 1951

Announcements

Board of Agricultural Research — The Government of India have set up a board to plan and coordinate agricultural research in the institutes under the Ministry of Agriculture the Indian Council of Agricultural Research Commodity Committees and the State Governments The board will work for maximum utilization of the existing research facilities and supervise the scientific publications issued by the Ministry of Agriculture and the I C A R The board will consist of Hon ble Shri K M Munshi Chairman Shri M D Chaturvedi Dr S Datta Shri W R Nater Dr B P Pal Shri K I Punjabi Dr S Ramanujam Dr K Ramaiah Dr S C Ray Dr K C Sen Sardar Datar Singh and Dr B Viswanath

Statistical Education Centre — An International Statistical Education Centre will be established at Calcutta under the auspices of the UNESCO and in collaboration with the Central Statistical Institute Calcutta The centre will provide instruction in the theory and practice of statistics to a restricted number of students belonging to Middle South and Far East countries Further information may be had from Prof K B Madhava Honorary Administrator of the International Statistical Education Centre C/o Indian Statistical Institute Presidency College Calcutta

PATENTS IN INDIA

THE REPORT ON THE WORKING OF THE PATENT Office in India covering the period 1942-1948 gives a comprehensive survey of the trend of inventions during the war and the post-war periods The number of applications for patents increased from 681 in 1942 to 2,610 in 1946 and thereafter dropped to 1,921 in 1948, presumably due to post-war unsettled conditions The number of applications originating in India recorded a steady increase from 252 in 1942 to 361 in 1948, Bengal and Bombay making a substantial contribution

During the war, a large proportion of applications filed related to armament industries, aircraft and other appliances concerning the prosecution of the war The activities in the armament industries related to better detonating arrangements for ammunition and in the improvement of cartridges and their cases, explosive mixtures and blasting compositions, automatic weapons and recoilless guns, safety devices and optical devices for range finding Attention was also directed to improved designs of shock absorbers and air filters for aircraft engines Attempts were made to utilize gas turbine engines for the jet propulsion of aircrafts, some of these applications related to construction of air compressors for such turbine units With increased activity in the field of aeronautics, there was also an increase in the number of inventions in wireless engineering, e g radio beacons for aircrafts, direction finding receivers, measuring distance by electromagnetic waves, radio glide path systems, multi-channel signalling by time-modulated electric pulses and directive antenna systems for microwaves, radar and television aids to navigation A number of inventions were also made in line communication engineering relating to line equipment for multi-channel carrier wave signal transmission systems, automatic telephone exchange circuits, particularly in the inter-exchange equipment and in the use of discharge devices like thermionic valves and cathode ray tubes in telephone exchange circuits for various types of indications and identification purposes in line circuits Other fields covered related to photo-electric methods of telegraph transmission and reception

In addition to armament and aeronautical industries, there was considerable activity with regard to metal working building construction, road and aerodrome runway construction, erection of bridges and special steels and alloys Most of the inventions in the field of metal working related to devices for mass production of metal tubes, pipes and rods of different shapes in a single operation and turning, forging and welding of metals In the metallurgical field, inventions mostly related to copper base and magnesium base alloys besides special alloy steels

Warfare in the east, in swampy woods and forests, has been responsible for a number of inventions relating to insecticidal compositions, anti-malarial drugs and other preparations for tropical diseases A large number of such compositions related to the use of DDT (dichloro-diphenyl-trichlor-ethane) in the form of emulsions

Indian inventors devoted their attention to problems arising out of the scarcity of raw materials such as fuels for internal combustion engines, mineral oils and others for lighting purposes A large number of inventions related to charcoal producer-gas plants Use of substitutes or waste materials such as paper substitutes from plant leaves paper pulp from bagasse, sizing materials from tamarind seeds, moulding products from jute and jute waste, and use of coir for reconditioning or making new tyres engaged a number of inventors Extraction of vitamins from fish oils, dehydration of foods and manufacture of tea and coffee also figured prominently

Just before the cessation of the war, there was a considerable increase in inventions in various branches of electrical industry viz vacuum discharge apparatus and cathode ray tubes, electric discharge devices, condensers of metallized paper rolls, electric switches, coupling devices, junction boxes, eddy current machines, fluorescent lamps and materials, layer type of dry batteries and controlling devices used in traction and lifts At the close of the war a number of applications relating to earth-working machines, bull-dozers and agricultural tractors were filed and almost all of them originated from the U S A

The number of applications for registration of designs filed during the years 1942 to 1948 remained practically constant with 414 in the year 1942 and 494 in 1948, except for a rise to 731 in 1943 A major portion of the applications filed related to textile designs and more than 90 per cent originated in India

During the period under review an exhibition of Indian Patents and Designs was organized for the first time in India at the Lord Reay Maharashtra Industrial Museum, Poona The exhibits have become a permanent feature of the Museum known as the Patents Section

INDIAN INSTITUTE OF SCIENCE BANGALORE

THE UTILIZATION OF OIL SEED CAKE AS A BASIC raw material for the production of subsidiary foods which would contain all the essential nutrients is one of the interesting problems investigated in the Department of Biochemistry Various oil cakes, groundnut, sesame, etc, are being investigated The best method of removing the residual oil from the cake and the optimum amount of oil that can be left in it without affecting its keeping quality are being worked out To improve the palatability and the nutritive value of the protein foods, dehydrated onions, spices, salt, yeast and calcium in suitable proportions is recommended

A number of useful investigations are in progress in the Communication Engineering Department of the Institute A manually operated pulse apparatus operating directly off the a.c supply mains is being developed to measure the penetration frequencies and virtual heights of the different layers of the ionosphere For the first time in India, studies in frequency modulation have been started at the Institute with the aid of a 250-watt frequency modulated transmitter working on 100 megacycles per sec and a frequency modulated receiver recently purchased from America. Field strength and signal to noise ratio in and around the Institute are being studied Investigations into the response of electrical circuits to steady state pulses have been taken up and the necessary equipment consisting of a pulse generator, a time base generator, etc, is being developed

An electronic type of ringing current generator for use in telephone exchanges to substitute the existing motor generator and magneto-generator sets has been developed The new generator can work directly from the a c supply mains and involves no moving or rotating parts Another line of research in progress in this connection is the development of a new type of key sender based on electronic principles to replace the present mechanical and electrical devices used in trunk exchange

A new method to connect a large number of circuits to a single source has been devised The method is based on the switching technique used in automatic telephony and enables the circuits to be connected to the source one at a time and in any desired order by depressing a set of plunger keys corresponding to the desired circuits

CENTRAL ELECTRO-CHEMICAL RESEARCH INSTITUTE KARAIKUDI

THE CONSTRUCTION OF THE CENTRAL ELECTRO-Chemical Research Institute, Karaikudi, whose foundation stone was laid on the 25th July 1948 by the Hon'ble Shri Jawaharlal Nehru, is expected to be complete by the end of 1951

The problem of adequate water supply has now been successfully got over Three bore-wells have been sunk yielding 70,000 gal in a 12-hr working day

The main building of the Institute will have a floor area of about 60,000 sq ft The Library, the Director's office and the Laboratories will be situated on the first floor and certain sections will be air-conditioned Besides the usual laboratory services such as gas, water and electric supply, certain sections of the workshop, the pilot plant and heavy investigation laboratories will be furnished with steam, compressed air, vacuum and D C. supply lines

The total estimated cost of the Institute is Rs. 10 lakhs for building and Rs 25 lakhs for equipment, stores and library The annual recurring expenditure for the first three years is estimated at Rs 2 5 lakhs per year

FOUNDRY SAND TESTING AT THE NATIONAL METALLURGICAL LABORATORY

A FOUNDRY SAND TESTING SECTION EQUIPPED with up-to-date equipment has been established at the National Metallurgical Laboratory, Jamshedpur to provide facilities for the study of moulding sands available in India The Laboratory will serve as a central research and control station and will offer full facilities to the Indian foundry industry for foundry sand testing Besides, the Laboratory has the following functions assigned to it (1) to prepare a suitable bibliography on the subject of moulding materials, (2) to review the sources of Indian moulding materials and report on their suitability for general foundry practice for steel, cast-iron and non-ferrous metals and alloys, (3) to study the fundamental characteristics which are of importance in the bonding power of clays, (4) to specify the properties of naturally bonded and synthetic sand mixtures for moulding and (6) to explore new sources of moulding sands and silica sands in collaboration with the Geological Survey of India

The problem of finding a suitable bond for synthetic sand mixtures is being investigated at the Laboratory The Indian bentonites, being of a calcium base, possess less swelling power and bonding capacity and cannot readily replace the sodium-base imported bentonites However, the calcium base Indian bentonite can be converted into sodium-base product through base exchange to serve as a substitute for the imported bentonite The following are a few of the problems planned for investigation at the Laboratory (1) the relation of the bond in naturally and synthetically bonded sand to stripping, burning on, etc, (2) investigations on the behaviour of synthetic bonds with clean high silica sand and weak clay-bonded sand, (3) effects of milling as affecting the properties of moulding sands, (4) investigations on the specific surface of sands as affecting the strength properties of sand-clay mixtures, (5) relation between the specific surface of sands as regards angularity and grain shape, (6) sintering phenomenon of moulding sands including the study of incipient fusion, (7) effect of pressure on the sintering point of moulding sands and "Compos", (8) volume changes in moulding sands and "Compos" up to 1,400°C, (9) effect of thermal conductivity of the moulds on the castings for the preparation of insulating sand mixtures for feeder heads, (10) study of the various types of clay and organic bonds for moulds and cores including artificial resins and other suitable hydrophilic compounds, and (11) effect of washes and paints on stripping and casting

INDIAN PATENTS

The following is a list of a few of the Patent Applications notified as accepted in the *Gazette of India* Part II Section 1 for September and October 1950

Inorganic Chemicals

43081 Manufacture of anhydrous caustic soda *Passing a gas stream up through caustic soda particles at* 200° 300°*C* — I C I Ltd

42232 Method for preparation of very fine aluminium trihydrate and uses thereof *Hydrolysing sodium aluminate solution by the Bayer s process at less than* 50°*C in presence of alumina gel* — Compagnie De Produits Chimiques Et Electrometallurgiques Alais Froges Et Camargue

Organic Chemicals

43408 Purification of aureomycin *Add to an acid solution of aureomycin of pH less than* 4 *a salt and an organic solvent for aureomycin* — American Cyanamid Co

40753 Preparation of new biguanide compounds *Reacting p chlorophenyl guanido carbothioloethyl imide with isopropylamine* — Guha & Guha

42542 Dyestuff intermediates and their manufacture and use *Reacting phthalic acid with cobalt salts under usual conditions for producing phthalocyanines but at a lower temperature* Williams

42848 & 42854 New vat dyestuffs *Condensing* 1 *molecular proportion of* 4 10 *dihalogeno anthanthrone with* 2 *molecular proportions of a mono aminoacedianthrone condensing aminoacedianthrones or halogeno acedianthrones with aromatic amines* — I C I Ltd

43520 Production of *meta* benzene disulphonic acid *Preparing mono sulphonate by benzene vapour phase sulphonation and reacting with oleum* — De Directie van de Staatsmijnen in Limburg handelend voor en namens den Staat der Nederlanden

42847 Vat dyestuffs *Nitrating acedianthrone in presence of sulphuric acid reducing the nitro compound and acylating the amino compound with* 1 *amino or* 1 *nitro anthraquinone* 2 *carboxylic acid* — I C I Ltd

42912 Tapping liquid slag from pressure gas producers *Tapping the slag notch connected to the gas producer* — Metallgesellschaft Aktiengesellschaft & Danulat

Miscellaneous Chemicals

42922 Anti bacterial compositions *Mixing streptomycin polymyxin and bacitracin* — Chas Pfizer & Co Inc

Lumber & Wood Products

42273 Tanning skin with zirconium compounds *Tanning in a liquor prepared by heating a zirconium mineral with sodium carbonate and a mineral acid and containing silica gel from* 0 1 *to* 2 *mols per mol of* ZrO_2 — Societe De Produits Chimiques Des Terres Rares

Machinery (Except Electricals) : Miscellaneous

41437 Sectional electrolytic cells of the diaphragm type *Frames by which cell units are laterally enclosed and division plates separating vertically adjacent units and clamped between said frames* — The International Electrolytic Plant Co Ltd Wood & Bowen

Metals & Metal Products

41249 Cold pressure welding of metals *Pressure for welding obtained by the release of stored energy welding being effected by impact pressure* — The General Electric Co Ltd

43115 Tubular articles of light alloys adapted to withstand high mechanical stresses such as handle bar shanks and sockets for cycles *A steering column of cycle made up of two semitubular parts coupled together and united* — Compagnie Generale De Vilvorde Cogevil Societe Anonyme

Textile & Textile Products

42162 Manufacture of textile materials *Treating textile materials with a solution of sodium benzoate and drying the material* The British Jute Trade Research Association

Miscellaneous

43052 Catalytic hydrogenation of carbon monoxide *Iron catalysts impregnated with alkali salts of a non volatile acid and synthesis gases containing acetylene are used* Ruhrchemie Aktiengesellschaft & Lurgi Gesellschaft fur Warmetechnik m b H

43128 Oxidation with chlorite solutions *Immersing the material in a solution of chlorine in an organic solution prior to immersion in the chlorite bath* Solvay & Cie

42996 Containers for electric batteries *Provided with a vent having a plurality of outlet apertures afforded between elements of absorbing and dissipating assembly* — I C I Ltd

43654 Refining lubricating oil of power operated engines *Comprising means for heating the oil for removing volatile impurities from the oil and means for returning the purified oil to the engine* — Comerford Bailey

Patented Inventions of the Council of Scientific & Industrial Research

IMPROVEMENTS IN INTERNAL COMBUSTION ENGINES

Patent No 35646

K A Nair & L C Verman

THIS INVENTION RELATES TO AN AIR CLEANING AND crank-case ventilation system for internal combustion engines The object of the present invention is to produce a simple and efficient device which will perform the functions of an air cleaner and crank-case ventilator Such a device would also serve as a crank-case breather by relieving the pulsating pressure set up inside the crank-case

The composite air cleaning and crank-case ventilation system (Figs 1 and 2) consists in connecting the atmospheric air intake attached to the carburetter (11) and the crank-case breather opening (15) to a common passage or reservoir (3) containing clean, dust free air at a pressure slightly below the atmospheric pressure The clean air may be supplied to the passage by an oil bath (16) or other type of cleaner, but it is preferable to use a porous fabric bag (3), the interior of which is at a pressure slightly below the atmospheric pressure and the air passing through is freed from atmospheric dust before entering the carburettor (11) The flow of crank-case vapour (arrow 6), which is controlled by the low pressure in the passage, is steady and no metering arrangement is necessary to control it The filter bag (3) is made of fabric having a pore size which would arrest dust particles and is of such an area as to cause only the small pressure drop inside the bag necessary to induce the crank-case vapour to flow into it The pressure inside the cloth bag (3) is controlled by the resistance to flow of air through the fabric and fluctuates but little for a given fabric bag

The crank-case opens directly into the reservoir or low pressure passage and has no other opening to the atmosphere The low pressure in the reservoir or passage causes the crank-case vapour to flow into it and thence to the engine by the engine suction Inevitable minute leakage past the pistons keeps up the pressure inside the crank-case and assists the flow of vapours from the crank-case to the reservoir and ensures automatic and effective ventilation of the crank-case

The device combines in a simple way all the functions of a carburetter intake air cleaner, crank-case breather, crank-case ventilator and air cleaner. The cost of construction of the device is only a small fraction of the cost of the four devices put together

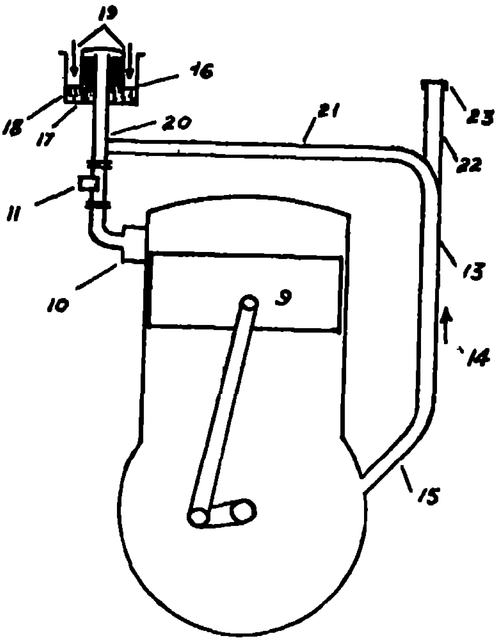
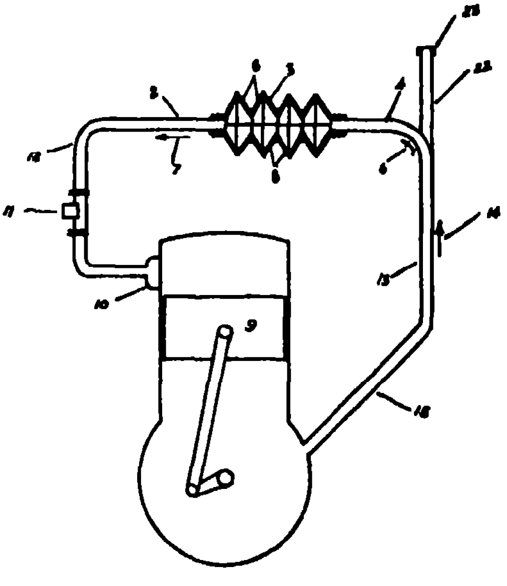


Fig 2



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Supplement

AROMATIC PLANTS OF INDIA

PART XIII

BY

S. KRISHNA & R. L. BADHWAR

FOREST RESEARCH INSTITUTE, DEHRA DUN

FAMILY

46 Myrtaceae

Journal of Scientific & Industrial Research, Delhi

1950, Vol. IX, No 3 (Pages 221-236)

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BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

AROMATIC PLANTS OF INDIA

Family XLVI—MYRTACEAE *(Continued)*

4 EUGENIA Mich *ex* Linn *

(In honour of Prince *Eugene* of Savoy of the seventeenth century a patron of botany)

THIS is a very large genus comprising over 1 100 species of generally evergreen trees and shrubs which are found chiefly in the tropical and subtropical regions throughout the world In India it is represented by about 80 species which thrive in moist localities often in evergreen forests and along the banks or in the beds of streams Its members have usually aromatic leaves tetramerous flowers and drupelike berries The young branchlets leaves parts of the flower and the fruit are usually dotted with pellucid oil glands

It is one of the largest perhaps the largest of the Indian genera of trees The great majority of the species are of little importance in forestry and relatively unimportant as a source of timber (except in the case of a few species) Nevertheless eugenias are common trees and their wood is used mainly as fuel Many of them have edible fruits and among them the important ones in India are the black plum [*E cumini* (Linn) Druce syn *E jambolana* Lam and *Syzygium jambolanum* DC] the rose apple or *gulab jaman* *E jambos* Linn syn *Syzygium jambos* (Linn) Alst and *Jambosa vulgaris* DC] and pitanga (*E uniflora* Linn) The bark of some trees is used locally as a tanning material and also in medicine

The dried flower buds of *E caryophyllata* Thunb [*E aromatica* (Linn) Baill *Syzygium aromaticum* (Linn) Merr & Perry] constitute the well known spice and yield an essential oil (clove oil of commerce) which is an excellent antiseptic Among other species found in India only *E cumini* and *E uniflora* have been investigated from the point of view of their essential oils These three species are described in detail later

The sweetish but rather dry fruit of *E jambos* Linn a handsome moderate sized tree grown in gardens is of the size of a small apple and has a delicate flavour which resembles rose water An oleoresin has been isolated from its root bark but the essential oil from the oleoresin has not been investigated (Wehmer)

The yellowish white flowers of *E alternifolia* Wight (*Syzygium alternifolium* Walp) of S India and Assam are sweet scented Similarly *E polypetala* Wight (*Jambosa polypetala* Walp) and *E oblata* Roxb (*Syzygium oblatum* Wall) of Assam and Bengal bear white scented flowers The greenish flowers of *E operculata* Roxb *Syzygium operculatum* (Roxb) Gamble of Sub Himalayan tract from Jumna to Assam and of Bengal are also aromatic The leaves of this tree have a pleasant smell when bruised and are said to be used in Indo China as a substitute for tea The flowers of the Ceylonese *E xanthocarpa* Thw possess a singular smell suggesting creosote

The heartwood of *E gardneri* Bedd (*Syzygium gardneri* Thw) of S India has a fleeting odour comparable with that of dried rose petals That of *E alternifolia* has also a fleeting noncharacteristic odour

The leaves of eugenias contain essential oils since they emit a pleasant fragrance when bruised Most of them however have not been chemically examined Among the foreign species the leaves of which have been investigated may be mentioned *E chequen* Molina of Chile [yielding about 1 1 per cent of an essential oil (cheken leaf oil) which consists of a hydrocarbon (probably *d* α pinene) cineole (about 15 per cent) and oxygenated bodies boiling between 220° to 280° (about 10 per cent)] *E apiculata* DC of Chile (yielding 1 27 per cent of a brown essential oil resembling myrtle in odour) *E smithii* Poir of Australia (yielding 0 28 to 0 44 per cent of a pale yellow essential oil containing 80 to 90 per cent of *d* α pinene

---

* The genus *Eugenia* as understood in the *Flora of British India* is nowadays usually split up into the genera *Eugenia Jambosa Myrciaria Syzygium* etc For practical convenience in a publication of this nature however the old arrangement of including these plants under one genus has been adhered to The common characters of the group are easy to recognize For the benefit of those readers however who may like to split the genus as stated above the species dealt with in this work are followed by other names as synonyms

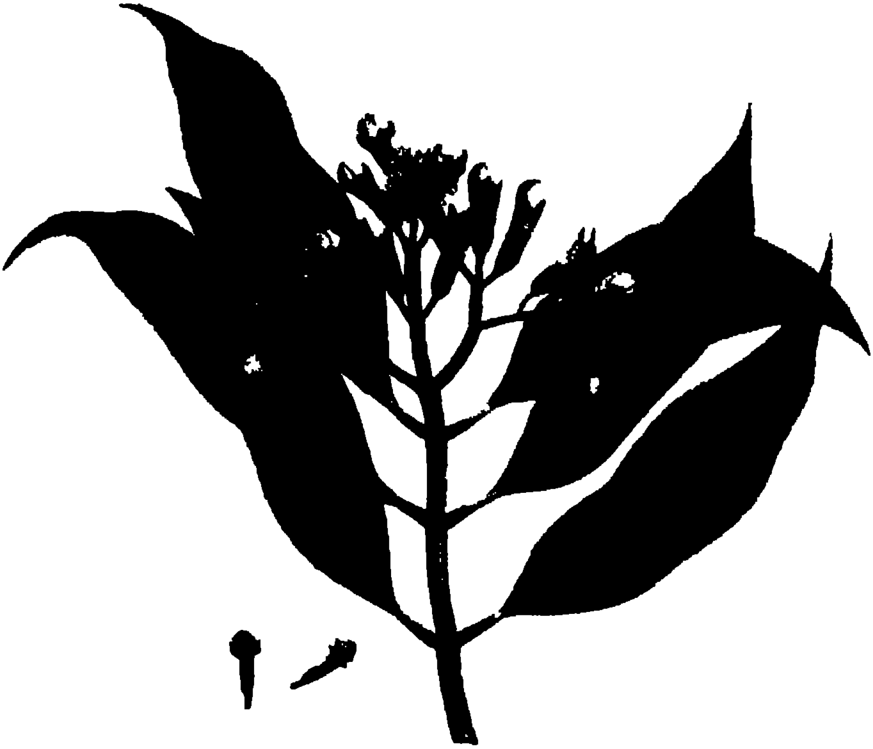

Fig 48 *Eugenia caryophyllata* Thunb

4 per cent of esters and 3 7 per cent of alcohols) *E occlusa* Kurz (*Syzygium occlusum* Miq) of Java yielding 0 05 per cent of an essential oil (salam oil) which contains citral in some quantity and other aldehydes] and *E pitanga* (Berg) Kiaersk of S America yielding an essential oil which contains citronellol geranyl acetate cineole terpineol sesquiterpenes and polyterpenes (Finnemore)

1 **Eugenia caryophyllata** Thunb *

Fl Brit Ind II 506 (without description)

(Clove Tree *Laung Lavang*)

This is a small bushy or cone shaped tree generally about 12 to 20 ft high but in some places attaining a height of 40 ft The bark is grey The leaves are lance shaped 3 to 5 in long 1 to 1½ in broad and gland dotted The presence of oil in these glands makes the leaves very fragrant and on a damp hot evening the scent of a clove tree can be detected from a considerable distance The flowers are borne at the ends of branches in small bunches consisting of three angular peduncles each of which bears three shortly stalked flowers on the tip The flower consists of a cylindrical ovary ½ in long above which are four sepals and above these are four petals which form a ball in the bud and fall off when the flowers open After fertilization the inferior ovary swells to form a large purple fruit usually containing one seed The fruit is about 1 in in length and ½ in in breadth This is called mother clove The clove of commerce is the unopened flower bud and is picked by hand when the base of the bud turns red When examined closely slight variations can be detected in the colour of the flower buds and in their size characterizing races or varieties but they are of little importance

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* Merrill & Perry (1939 *Mem Gray Herb* No 4 p 196) suggest *Syzygium aromaticum* (Linn) Merr & Perry as the name for this plant Another common name under which this plant is often referred to in the literature is *Eugenia aromatica* (Linn) Baill

The clove is one of the most widely used culinary spice and the essential oil obtained from it is used in perfumery manufacture and in medicine It is a native of some volcanic islands in the Moluccas namely Tidore Ternate Mortir Machian and Batchian but is now extensively cultivated in Zanzibar and Pemba and also to a large extent in Amboina Madagascar Penang etc In India* it is cultivated to an extent in the south in tracts adjoining the spice gardens of the late East India Company in Courtallam in the Tinnevelly district at Burliar in the Nilgiris in Travancore and in Cochin Its successful cultivation appears to be limited to islands between the latitudes 20° north and 20° south of the equator and within a few hundred feet above the sea level It does not usually thrive at any distance from the sea — hence the old saying that the clove tree must be able to see the sea

The cloves were known in China as early as about 250 B C when officers of the Court were required to hold the spice in their mouths before addressing the Sovereign in order that their breath might have an agreeable odour In the early Christian Era it was an object of trade at Alexandria in Egypt and was passed forward to Rome The earliest mention of the spice in Indian medical works occurs about A D 600 About A D 400 it was fairly well known in the Mediterranean region and in A D 800 throughout Europe The early trade to Europe changed hands in the Indian ports About that time it was known by the Sanskrit word *lavanga* in India and eastwards but the Arabs used the word *karanful* In the year 1808 the Arabs brought the first cloves to Pemba and Zanzibar but it took considerable time before it was recognized that the areas were specially suitable for the cultivation of the spice Today more than four fifths of the world s cloves are produced in these two islands

The tree is said to thrive in a dark loamy soil with a substratum of a mixture of dark yellow earth and gravel In Zanzibar a red clay soil is considered better than a lighter more open soil In the Straits Settlements the black soil of the valleys overlying a stiffer clay is suitable Sandy soil is unsuitable and still worse is wet water logged soil (Ridley 1912 *Spices* p 155)

The plant is usually raised from seed but it can also be propagated by layers In Zanzibar the seeds are first soaked in water for 3 days and when germination has started they are sown 6 in apart in shaded beds When the seedlings are 6 in high i e when they are about one year old they are hardened by removing the shade and exposing to the sun for a month or two They are then planted in the field 22 to 30 ft apart in pits 2 × 2 × 2 making on an average 100 trees per acre

In the rich soil of Zanzibar no manure is given other than the dead leaves etc lying about which are swept to the base of the tree

In the Straits Settlements cow dung is used Mulching with cut grass is said to be beneficial to the young plants and light shade especially protection from the afternoon sun is stated to be necessary for their healthy growth and productiveness

In Zanzibar and Penang the tree commences to produce flower buds in the fourth or fifth year after planting If the soil were inferior it is said to take a little longer In the Moluccas 6 to 8 years are said to be required (Ridley *loc cit*) The tree lives up to 75 years and sometimes even up to 130 years A tree as old as 150 years is also known (Burkill 1935 *Dictionary of the Economic Products of Malay Peninsula* 2 961)

The buds are gathered from August to December in Zanzibar and from November to January in the Straits Settlements In the Moluccas the harvest takes place twice a year one in July and the other in December The buds are generally picked off by hand hooked sticks being used to pull down the branches They are then spread out on mats to dry them in the sun In Amboina they are first dried on a framework over a slow wood fire which gives them a brown colour and then are dried in the sun when the colour changes to black In Zanzibar after the cloves are gathered the buds are separated from the stalks They are then dried for 6 or 7 days, during which time they lose up to 60 per cent of their weight (Ridley, *loc cit*)

---

* For an account of the cultivation of cloves in India the reader is referred to the *Report on an enquiry into the cultivation of cloves in India* by A K Y N Aiyer published under the auspices of the Imperial (now Indian) Council of Agricultural Research (Manager of Publications Delhi 1938 p 1-79)

The average weight of cloves produced by each tree in a season in Amboina is said to be 5 lbs , in Sumatra 6 or 7 lbs , in Penang 5 lbs , and in Moluccas 4½ lbs The average yield per acre planted with 100 trees is estimated to be about 375 lbs of dry cloves, if only two thirds of the trees are in full bearing condition A much higher yield is reported from Zanzibar (20 lbs of cloves to a tree in a 10-year-old plantation and above 100 lbs per tree in a 20-year-old plantation), but this, according to Ridley (*loc cit*), appears to be exaggerated According to Poucher, individual trees have been known to produce 75 lbs of dry cloves in Zanzibar, but the average yield from large plantations under efficient management may be taken at 8 to 10 lbs per tree per annum, which is equal to 800 to 1,000 lbs of dry cloves per acre

According to Williams (1949 *Chem & Drugg* , **152** 159), the clove tree is a fluctuating bearer and the yield of cloves in some years may be even 50 per cent of the normally expected crop

A mysterious disease, known locally as " sudden death " disease, is known to affect a large number of the older clove trees in Zanzibar and Pemba This is believed to be caused by a virus The only method by which its spread is prevented is by cutting out the dead and other trees in contact, and destroying them (Anon , 1949 *Gdnrs' Chron* , **125** 178 , Williams, 1949 *Loc cit*)

Cloves have a strong spicy odour and a pungent aromatic taste When indented with finger nail they readily exude oil They sink when placed in freshly boiled and cooled water, and this method is employed to distinguish genuine cloves from those exhausted of the essential oil The quality is also sometimes judged by setting a clove on fire and observing how it burns

According to Burkill (1935. *Dictionary of the Economic Products of Malay Peninsula*, **2** 961), Penang cloves have had the best name in trade for their appearance , they are large and plumpy and of bright reddish colour Amboina cloves are similar but smaller Zanzibar cloves are darker, leaner, and still smaller According to Parry (1945 *Spice Handbook* p 37), Penang and Amboina cloves are generally considered superior, but Zanzibar and Madagascar cloves are also of excellent quality and flavour Pemba cloves, which were previously regarded as somewhat inferior, are now said to be similar to the Zanzibar cloves. Good quality cloves are reddish brown, plump, but little wrinkled, ½ to ¾ in in length, and in shape resemble a round-headed nail (the word clove is derived from the French *clou*, a nail, and the Latin *clavus*, a nail) If they were not carefully dried and stored, the colour becomes darker and the sample musty Finally, the epidermis becomes pale and wrinkled, and the cloves of this type are known as " khoker "

The cloves are sometimes adulterated by the inclusion of mother cloves (the mature fruit), excess of clove stems, and exhausted cloves The immature cloves, which are gathered before they are ripe, shrink and become shrivelled They are also added to some consignments On 1 January, 1926, there came into operation a decree in Zanzibar to prevent the adulteration of cloves. Particulars of this decree are given in *Perfum essent Oil Rec* , 1926, **17** 3

The cloves are graded according to the appearance and impurities present According to Parry (*loc cit*), Zanzibar cloves are graded as under —

Special grade Extraneous matter (i e , stems, mother cloves, foreign and inferior matter) 3 per cent , khoker 2 per cent , and moisture 16 per cent

Grade 1 Extraneous matter 5 per cent , khoker 3 per cent , and moisture 16 per cent

Grade 2 Extraneous matter 5 per cent , khoker 7 per cent , and moisture 16 per cent

Grade 3 Extraneous matter 5 per cent., khoker 20 per cent , and moisture 16 per cent

According to the British Pharmacopoeia (1932), cloves should not contain more than 5 per cent of its stalks and not more than 1 per cent of other organic matter The ash should not be more than 10 per cent and acid-insoluble ash not more than 0 75 per cent Pitted sclerenchymatous cells above 70 microns in diameter should be few or absent (limit of stalks 5 per cent) and starch grains absent (absence of clove fruits and of cereals)

Twenty years ago, the world demand for cloves was about 12,000 tons (26 88 million lbs) Out of this about 9,000 tons were used for culinary purposes and about 2,000 tons for distillation of the essential oil The greater part of the oil is used for the synthesis of vanillin, and the rest in medicine and perfumery (Anon , 1929 *Perfum essent Oil Rec* , **20** 236) Larger quantities of cloves are, however, being marketed at present For purposes of perfumery the Amboina cloves are preferred since they are said to yield a much finer oil than the cloves from other places (Poucher)

Zanzibar and Pemba islands have been supplying about 83 per cent of the world demand for cloves (Anon , 1937 *Chem & Drugg* , **127** 692 , Anon , 1949 *Gdnrs' Chron* , **125** 178) During the crop year ending 30 June, 1945, Zanzibar and Pemba produced about 23 million lbs of cloves as compared to about 36 million lbs in the previous year The seasonal year ending 30 June, 1949, closed with a crop of 13 7 million lbs of cloves and the harvest for the crop year ending 30 June, 1950, is expected to come up to 17 5 million lbs In 1946, Zanzibar exported 34 5 million lbs of cloves of which India imported 54 7 per cent During recent years, the production of cloves in Madagascar has assumed an importance The export of cloves from this island amounted to 7 1 million lbs in 1945 and to 9 9 million lbs in 1946 For details of production of and trade in cloves the reader is referred to the *Annual Reports* by Schimmel & Co and the issues of the *Chemist & Druggist.*

The import of cloves into India has been steadily increasing As compared to the average import of 8 7 million lbs of cloves per annum during the quinquennium 1931-32 to 1935-36, her imports have increased to an average of 14 5 million lbs per annum during the quinquennium 1944-45 to 1948-49, the highest figure being 22 9 million lbs valued at Rs 14 millions during 1948-49 Before 1925, India had a large re-export trade in cloves amounting to about 27 per cent of the quantity imported From 1926-27, however, the re-export fell very steeply and has now practically disappeared For details of the Indian trade in cloves the reader is referred to the *Accounts Relating to Sea-borne Trade and Navigation of India* (formerly *Annual Statements of the Sea-borne Trade of British India*, etc)

Aiyer (1938. *Report on an enquiry into the cultivation of cloves in India* p. 8, 64) states that the Indian import figures include not only pure cloves, but also "spent" cloves, i e , from which oil has been removed by distillation, clove stems, and spent clove stems, which formed about 15 per cent of the total imports for the decennium ending 1931-32, and that there was no material change up to 1935-36 The present authors are not in a position to comment upon the situation after 1936 It would, however, be interesting to know whether clove stems and spent clove stems are still being imported, particularly in view of the fact that, as stated on p 227, the export of clove sticks from Zanzibar has been prohibited since 1936 The authors are also unaware of the reason for the import of spent cloves, unless it be for the purpose of adulteration of pure cloves

Few aromatic plants are as rich in oil as the cloves, which yield from 14 to as much as 23 per cent of an essential oil The cloves are distilled either in water or with dry steam The former method gives an oil of lower specific gravity, and this, therefore, floats on water in the receiver, while the oil obtained with steam is heavier and sinks to the bottom These two kinds of clove oil are known in the market as "opt" and "strong", respectively They differ in their phenol content which in the light oil varies from 78 to 89 per cent and in the heavy oil from 88 to 95 per cent The lighter variety is used mainly in perfumery and pharmacy, and the heavier oil for the manufacture of vanillin The normal commercial oil, however, is usually a mixture of both the varieties The constants of the oil are sp gr 1 044 to 1 070, $[\alpha] -0\ 2°$ to $-2\ 3°$, and n 1 528 to 1 540 It is soluble in 1 to 3 volumes of 70 per cent alcohol It usually contains 85 to 92 per cent of eugenol

According to the British Pharmacopoeia (1932), the clove oil should contain not less than 85 per cent and not more than 90 per cent v/v of eugenol Its sp gr $^{15\ 5°}$ should be 1 047 to 1 060, $n^{20°}$ 1 528 to 1 537, and it should be soluble in 2 volumes of 70 per cent alcohol

The principal constituent of the oil of cloves, as is apparent from the above data, is eugenol Along with it a small quantity, about 3 per cent , of aceteugenol is also present The minor constituents are many and are present only in traces. These are caryophyllene, esters of eugenol, methyl alcohol, furfural, vanillin, salicylic acid, methyl benzoate, methyl *n*-amyl ketone, methyl heptyl ketone, valeraldehyde, methylamylcarbinol, methylheptylcarbinol, benzyl alcohol and dimethylfurfuraldehyde (Parry)

Although eugenol, aceteugenol, and caryophyllene are present to the extent of 99 per cent in clove oil, they are not responsible for the characteristic fresh and almost fruity note of the oil This is one of the many examples of the importance of trace substances in natural perfumery and flavouring oils In clove oil the most important trace substance, according to Schimmel & Co, is methyl *n*-amyl ketone (Smith, 1946 *Perfum essent Oil Rec*, **37** 143)

The clove oil distilled from cloves from wild-growing trees in the Moluccas has been found by Meijer (1946 *Rec Trav chim Pays-Bas*, **65** 843, *vide* Schimmel & Co, 1946 *Ann Rep* p 13) to be devoid of eugenol This is most interesting, since the oil from the cultivated cloves usually contains 85 to 92 per cent of eugenol The oil from wild cloves, which was obtained in a yield of 4 to 6 per cent, however, contained two new compounds named eugenine, a 5-hydroxy-7-methoxy-4-methyl-coumarin, and eugenone, a 2, 6-dimethoxy-4-hydroxyacetophenone The constants of the oil were sp gr $^{27\ 5°}$ 0 9028 to 1 0005, $n^{30°}$ 1 4994 to 1 5268, and $[\alpha]$ $-16\ 0°$ to $-75\ 9°$ The wild cloves are larger and less odorous than the cultivated ones

Samples of cloves grown in India have been analysed by the Mysore Department of Agriculture and shown to yield on steam distillation 14 2 to 20 8 per cent of clove oil, which contains 77 to 93 per cent of eugenol (Aiyer, 1938 *Report on an enquiry into the cultivation of cloves in India, Imperial Council of Agricultural Research*, Miscellaneous Bulletin No 20 pp 1-79) A sample of cloves (including stalks) of Indian origin has been found to yield 15 5 per cent of clove oil on moisture-free basis, which comes to about 9 4 per cent on the trade sample This oil had the following characteristics sp gr $^{30°}$ 1 057, $n^{30°}$ 1 532, saponification val 51 85, acid val 1 02, acetyl val 211 2, and phenols 92 5 per cent [Nair, Nair & Varier, 1948 *Proc 35th Indian Sci Congr* (*Abstr*) p 33] The oil has also been found to contain aceteugenol, α- and β-caryophyllenes, and traces of furfural and methyl alcohol [Nair, Varier & Nair, 1949 *Proc 36th Indian Sci Congr.* (*Abstr*) p 102]

The cloves are used primarily as a spice. They are also used in Asia as a masticatory to sweeten the breath In medicine they are considered as stimulating and carminative, and are used against flatulence, dyspepsia, and as an adjuvant to other medicines.

The oil of cloves, like other volatile oils, is antiseptic and antiputrescent, and is often employed as a preservative. It is used internally as an antispasmodic and carminative Applied externally, it acts as a rubefacient, counterirritant, and slightly anaesthetic It is also used to allay pain in dental caries, and as a dressing and an ingredient of temporary fillings in dental practice On account of its flavour and disinfectant properties, it is much used in tooth pastes and mouthwashes It is used in microscopy as a clearing agent

The clove oil is largely employed in soap perfumery for imparting carnation odour to soaps A small quantity of eugenol, the chief constituent of the oil, is used as such in the manufacture of clove and carnation odours, and a certain amount is converted, by heating with alkali, into its isomer *iso*eugenol, which has a finer carnation odour, and is used for the same purpose The bulk of eugenol is, however, used for the manufacture of vanillin (artificial vanilla), the famous flavouring agent The residue of clove oil, after the removal of eugenol, is used as a cheap soap perfume under the name " light clove oil "

Essence of cloves used for flavouring confectionery, liqueurs, etc, is made by dissolving 4 oz of clove oil in one gallon of spirit

As stated earlier, India is the largest importer of cloves from Zanzibar, her imports in 1948-49 amounted to 22 9 million lbs valued at Rs 14 millions Despite the fact that the spice is extensively used in the country, there is a general feeling that it is somewhat strongly pungent. There is no doubt, therefore, that the public would welcome a clove which is somewhat milder With a view to marketing such a clove, it is suggested that a part of the imported pure cloves be distilled for the removal of two thirds of its oil content, leaving the remaining one third in the cloves. This practice while meeting the general desire of consumers in the country will also enable India to become one of the prominent producers of clove oil It would also make available cloves at a cheaper rate than at present

As has been stated earlier (Krishna & Badhwar 1947 *J sci industr Res India* **6** Aromatic Plants of India Suppl p 45) clove scented perfume is also present in plants of other families e g in carnation (*Dianthus caryophyllus* Linn) of the family Caryophyllaceae in the large white flowers of the Indian climber *Rivea hypocrateriformis* Choisy (clove scented creeper Midnapore creeper) and in the white flowers of the twiner moonflower [*Calonyction bona nox* (Linn) Boj syn *Ipomoea bona nox* Linn var *grandiflora* (Roxb) C B Clarke] which is found throughout India either cultivated or wild the last mentioned two plants belong to the family Convolvulaceae The leaves of *Cinnamomum zeylanicum* Breyn barks of *Cinnamomum culilawan* Blume (clove bark) of Amboina and *Dicypellium caryophyllatum* (Mart) Nees (clove cassia cassia caryophyllata) of Brazil and the fruits of *Ravensara aromatica* J P Gmel (clove nutmeg) of Madagascar etc all belonging to the family Lauraceae have clove like fragrance The leaves and fruits (allspice) of *Pimenta officinalis* Lindl and leaves of *P acris* Kostel (Jamaica bay berry wild clove) etc of Myrtaceae family also have clovelike odour

Royal cloves is a term used for an abnormality of the clove These were at one time prized on account of their rarity and extraordinary stories are told about them

The flower stalks (the so called clove stems) separated from the cloves when drying the latter are an article of commerce and were exported from Zanzibar and Pemba for adulterating powdered cloves and for making clove oil However with the building of clove oil factory in Zanzibar in 1936 and the prohibition imposed upon the export of clove stalks a large amount of the stalks are used in Zanzibar for the distillation of the oil The manufacture of the clove stalk oil in Zanzibar is the monopoly of the Clove Growers Association During the half year July to December 1937 they exported 58 080 lbs of clove stalk oil and in the months of January to March of the same year another 17 250 lbs of the oil were exported (Schimmel & Co 1930 *Ann Rep* p 25) The report of Zanzibar Clove Growers Association (Anon 1942 *Oil Col Tr J* **101** 627) for the last quarter of 1941 shows that the supply of clove stalks from Zanzibar amounted to 2 77 million lbs of which the distillery absorbed 1 79 million lbs According to Schimmel & Co (1945 *Ann Rep* p 13 1946 *Ibid* p 13) the export of clove oil and clove stalk oil from Zanzibar varied during 1940 to 1944 from 274 796 to 494 424 lbs per annum The export of these however reached the unusually high figure of 525 313 lbs in 1945 but the export of 410 677 lbs in 1946 was nearer the prewar average According to the report of Zanzibar Clove Growers Association (*vide Chem & Drugg* 1949 **152** 259) a total of 3 14 million lbs of clove stalks were obtainable for distillation of the oil during the seasonal year July 1948 to June 1949 This amount of stalks (containing 4 to 6 per cent of oil) should yield about 157 000 lbs of oil

The clove stalks are moderately aromatic and yield 4 to 6 per cent of oil of cloves as against 14 to 23 per cent from ordinary clove buds This oil is inferior in odour and not as suitable as clove oil for perfumery but it can be used for the manufacture of vanillin According to Smith (1946 *Perfum essent Oil Rec* **37** 143) its sp gr varies from 1 055 to 1 063 and it contains 90 to 95 per cent eugenol The eugenol content is sometimes as low as 82 per cent and the refractive index at 20° varies from 1 5349 to 1 5382 (Schimmel & Co 1946 *Ann Rep* p 13) Gadre (1921 *J Indian Industr* **1** 1) gives the following particulars of clove stem oil distilled in India sp gr $^{25^\circ}$ 1 054 n^{25° 1 5345 and eugenol by absorption 93 per cent (free eugenol 69 8 per cent)

The mother cloves (mature dried fruits) are less aromatic than the cloves and yield 6 5 per cent of an essential oil They are also sometimes exported A sample of the oil distilled by Schimmel & Co [*vide J chem Soc* 1915 A **108**(1) 828] was found to have the following characteristics sp gr 1 0933 *n* 1 5433 [α] −3 11° soluble in 1 8 and more volumes of 70 per cent alcohol and phenol content 88 per cent (consisting of eugenol 60 per cent and a solid phenol having paraffinlike odour 35 per cent)

The clove leaves yield 4 to 5 per cent of an essential oil which is a valuable article of commerce The oil has sp gr 1 032 to 1 067, n 1 532 to 1 539, $[\alpha]$ —0 30° to —2°, and eugenol content 75 to 93 per cent (Parry) The oil produced in Madagascar is derived mainly from clove leaves and only a small portion from clove stems, the cloves proper not being distilled at all The distillation of the leaves was begun in 1911, and since then the production has gradually increased Whereas in 1913 Madagascar exported about 3,000 lbs of clove-leaf oil, the export of the oil increased to about 7,000 lbs in 1920, about 300,000 lbs in 1932 (Anon , 1935 *Perfum essent Oil Rec* , **26** 204 , Schimmel & Co , 1936 *Ann Rep* p 20), about 676,000 lbs in 1939, 564,000 lbs in 1945 (Schimmel & Co , 1945 *Ann Rep* p 13), and to about 732,000 lbs in 1946 (Schimmel & Co , 1946 *Ann Rep* p 13)

The clove-root oil is obtained by distillation from the roots of the clove tree cultivated in Zanzibar and Pemba When freshly distilled, the oil is bright yellow in colour, and the yield averages about 6 per cent The composition, odour, and quality of this oil compare favourably with that obtained from clove buds (Poucher) It contains 85 to 95 per cent of eugenol [1922 *Oil Paint Drug Rep* , **102**(7) 44D, *vide* Wehmer]

2 **Eugenia cumini** (Linn) Druce*

E jambolana Lam , Fl Brit Ind , **II**, 499

(Black Plum, *Juman*)

This is a moderate-sized to large tree with dirty-white, sweet-scented, about ¼ in wide flowers which are arranged mostly in threes in trichotomous panicles The obovoid-oblong or subglobose, purplish-black fruit, which is sometimes as large as a pigeon's egg, is relished by all classes of people The tree is found all over India, wild or cultivated, generally along banks of rivers and in moist localities, ascending to an altitude of 5,000 ft in N India and to 6,000 ft in the Nilgiris It is often planted in groves and by the roadside

A syrup prepared from the fruits is considered useful, in indigenous medicine, in the enlargement of spleen The seeds have the reputation of being useful against diabetes , they contain the glycoside jamboline

The peculiarly flavoured Mahabaleshwar honey is said to be due to the bees obtaining the major part of the honey from the flowers of this tree No essential oil has, however, been extracted from the flowers or the leaves

The seeds are reported to yield 0 05 per cent of a pale-yellow oil having an agreeable odour with sp gr $^{20^\circ}$ 0 926, and $[\alpha]$ —5 42° (Power & Callan, 1912 *Pharm J* , **88** 414)

3. **Eugenia uniflora** Linn

Fl Brit Ind , **II**, 505

(Pitanga)

This tree has nearly sessile, gland-dotted leaves, usually solitary flowers, and globose, torulose berries It is a native of S America, but is becoming naturalized in parts of India (*Fl Brit Ind*)

The fruits, according to Hill (1937 *Economic Botany* p 448), are considered to be the best of the genus , they are grown in Florida and California for use as a fresh fruit and for making jellies and sherbets

The leaves yield 0 14 per cent of an essential oil of sp gr 0 963

The seeds yield 0 043 per cent of an yellowish essential oil having an aromatic pepper-like odour (Peckolt, 1903 *Ber dtsch pharm Ges* , **13** 130)

5 MELALEUCA Linn

(From the Greek *melas* — black and *leukos* — white , in allusion to the black trunk and white branches in one of the species)

This genus comprises about 100 species of Australian trees or shrubs, only one of which extends into the tropical regions of Asia, including India Its members have lanceolate or linear, gland-dotted leaves, flowers in heads or spikes, and a loculicidally dehiscing capsule , the stamens are numerous and are more or less united at their bases into 5 bundles opposite the petals and are longer than the latter

The wood of many species contains a resin It is used as firewood The timber of some is also used Most of the species contain essential oils in the leaves, but, generally speaking, the low yields render the extraction of oils from them uneconomic. Only a few of them have, therefore, been exploited commercially The essential oils derived from members of this genus are more or less characterized by the presence of cineole

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* Some botanists prefer to call it *Syzygium jambolanum* DC

The cajuput oil of commerce is obtained from *M leucadendron* Linn , and is widely used in medicine as a counterirritant and antiseptic *M leucadendron* and its oil are described later in detail

According to Penfold & Morrison (1937 *Aust J Pharm*, **52** 274 , 1934 Australian Tea Trees of Economic Value, Part I *Bull tech Mus*, *Sydney*, No 14)*, the leaves and terminal branchlets of the Australian *M alternifolia* Cheel (narrow-leaved paperbark tea tree) yield 1 to 1 8 per cent of a pale lemon-tinted oil with a pleasant odour reminiscent of nutmeg or mace Many commercial samples are water white The oil and its water emulsion have remarkable antiseptic properties for use in surgical and dental work It has the power of penetrating pus and mixing with it in a manner which causes it to slough off, leaving a healthy surface The germicidal value of the oil is 11 to 13 times that of phenol, it has also the advantage of being nonpoisonous and nonirritant to delicate membranes and tissues — in these respects differing from the well-known germicides containing a large percentage of carbolic and cresylic acids The oil which was being produced in Australia to the extent of about 1,600 to 2,000 gallons annually up to 1944, is mostly sold under the proprietary names of " Ti-Trol " (the oil) and " Melasol " (the emulsion) It has the following characteristics sp gr 0 8950 to 0 9050, $[\alpha]$ +6 8° to 9 8°, *n* 1 4760 to 1·4810, ester val 2 to 7, the same after acetylation 80 to 90, soluble in 0 6 to 0 8 volumes of 80 per cent alcohol, and cineole content less than 10 per cent The principal constituents of the oil are *d*-α-pinene, α- and γ-terpinenes, cymene, cineole, Δ^1-terpineol-4, sesquiterpenes, etc In a more recent publication, Penfold & Morrison (1946 *Aust J Pharm*, **27** 723) state that the demand for this oil now greatly exceeds the supply During the war it played a big part in reducing the incidence of industrial dermatitis in machine shops A small percentage of the oil added to cutting oils prevented infection of skin abrasions, especially of the hands, caused by metal filings and turnings The high germicidal value and nontoxic and nonirritant properties of the oil are due to the complex mixture of terpinenes, the alcohol terpineol, and small percentage of cineole present in the oil When the oil was originally exploited, it was established by clinical and medical tests that the cineole content should not exceed 10 per cent for medicinal and dental work As the demand for the oil increased and new areas were opened up, it was found that in some cases the trees yielded oils containing 15 to 30 per cent of cineole, and even up to 64 per cent of this constituent The " forms " with higher proportion of cineole are unsuitable for medicinal and dental use As a result of studies on forty-nine trees growing under natural conditions and distributed over wide areas, Penfold, Morrison & McKern (1949 *Perfum essent Oil Rec*, **40** 149) have found an excellent correlation between the optical rotation and cineole content of the oils from different forms, and have grouped them under three heads In the " low " cineole-content group, optical rotation varies from +6 45° to +8 58° (average +7 69°) and cineole content from 6 to 14 per cent (average 10 per cent) , in the " medium " cineole-content group they vary from +3 40° to +5 50° (average +4 60°) and 31 to 41 per cent (average 38 per cent), respectively , and in the " high " cineole-content group from +1 64° to +2 90° (average +2 32°) and 54 to 64 per cent (average 61 per cent), respectively According to Poucher, it would appear to have no application in fine perfumery, but, when blended with lavender, bergamot, etc , should make an excellent cinema spray It is used in medicated soaps and dentrifices, and in solution is stated to have remarkable contraceptive properties

The leaves and terminal branchlets of a related species, *M linariifolia* Sm of Australia, yield 1 5 to 2 per cent of an essential oil which has been utilized to an extent The characteristics of the oil, which has the myristic or nutmeg odour and a high germicidal value, are sp gr 0 8927 to 0 8992, $[\alpha]$ +3 3° to +6 8°, *n* 1 4752 to 1 4780, ester val 1 3 to 2 7, and the same after acetylation 58 to 82 Its principal constituents are α- and γ-terpinenes, cymene, cineole (16 to 20 per cent — sometimes up to 30 or 40 per cent), Δ^1-terpineol-4, sesquiterpenes, etc

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* From the *British Chemical Abstracts*, 1948, B III p 66 it appears that a revised edition of this Bulletin has been issued by Penfold & Morrison in 1946, but we have not seen a copy of it

(Penfold & Morrison, 1937 *Aust J Pharm* , **52** 274 , Penfold & Morrison, 1934 Australian Tea Trees of Economic Value, Part I *Bull tech Mus* , *Sydney*, No 14) This oil is used in Australia for soaps and perfumery and industrial purposes (Anon , 1944 *Bull imp Inst* , *Lond* , **42** 161)

Recently, Penfold, Morrison & McKern (1948 *Perfum essent Oil Rec* , **39** 141) have drawn attention to the Australian *M viridiflora* Soland *ex* Gaertn as a potential source of nerolidol and linalool Nerolidol is in demand in high-class perfumery but is rather a rare ingredient It can also be converted into farnesol, another rare ingredient used in perfumery *M viridiflora* from New Caledonia has been well known to yield the niaouli oil or gomenol which in general resembles the cajuput oil and contains 35 to 60 per cent of cineole According to Penfold & Morrison (*loc cit*), this species presents great variation in the yield and type of essential oils from different localities, and even from tree to tree in the same area From the seeds of a form of this species, possessing foliage with a rose-like odour and growing in New South Wales, they raised some trees The foliage from the cultivated trees yielded 1 7 to 2 6 per cent (calculated on freshly cut leaves and terminal branchlets) of an essential oil Apart from a little benzaldehyde the oil was found to be a simple binary mixture in proportions of about 70 per cent nerolidol and 30 per cent linalool Naves has recently discussed other new sources of nerolidol and farnesol from some American species of *Myroxylon* and *Myrocarpus* (both of the Leguminosae family), which have been dealt with under the account of Leguminosae (Krishna & Badhwar, 1949 *J sci industr Res* , *India*, **8** Aromatic Plants of India, Suppl p 148)

Although essential oils have been distilled from time to time from a number of species of this Australian genus, only one more species, *M bracteata* F Muell , appears to be of some interest to the perfumer (Poucher) The leaves and terminal branchlets yield about 1 per cent of a pleasant aromatic oil resembling methyleugenol in odour It consists principally of methyleugenol (70 per cent), eugenol, cinnamic acid, cinnamaldehyde, and *l*-phellandrene. This is another abnormal oil for the genus, since cineole is absent (Finnemore)

From among the constituents isolated from essential oils of this genus may be mentioned aldehydes, such as butyraldehyde, valeraldehyde, benzaldehyde, and cinnamaldehyde , alcohols, such as amyl alcohol, cinnamic alcohol, terpineols, eudesmol, nerolidol, and linalool , phenolic compounds, such as phenol, eugenol, and methyleugenol , acids, such as cinnamic acid , esters, such as terpineol acetate, terpineol butyrate, terpineol valerate, and terpinyl acetate , and terpenes, such as pinenes, limonenes, phellandrenes, dipentene, terpinene, and cymene

1 **Melaleuca genistifolia** Sm

This is a small, elegant tree with alternate, linear-lanceolate leaves which are $\frac{3}{4}$ in long and $\frac{1}{10}$ in broad, spikes about 1 in long, and yellow stamens It is indigenous to Australia, but has long been grown in Saharanpur and Lahore

According to Baker & Smith (1911 *J roy Soc N S W* , **45** 365 , *vide* Finnemore), the Australian specimens have been found to yield 0 526 per cent of an essential oil, which consists mainly of *d*-pinene, less than 2 per cent of cineole, and traces of aldehyde Its characteristics are sp gr 0 880, [α] +32 7°, n^{22° 1 470, saponification val 6 8, and insoluble in 10 volumes of 80 per cent alcohol

The crude oil has a marked turpentine odour, and it might be of value as a substitute for turpentine But the yield is too low for economic exploitation

2 **Melaleuca leucadendron** Linn

Fl Brit Ind , II, 465

(Bottle Brush, Cajeput, Cajuput, *Kayaputi*)

This is an evergreen tree often of a large size with pendulous branches, or stunted with stiff erect branches The leaves are thick, narrow and 6 to 8 in. long, or broader and 2 to 4 in long, elliptic or lanceolate, 3 to 7 nerved, and gland-dotted The whitish flowers are borne in dense interrupted spikes 2 to 6 in long, which are terminal at first but are later surmounted by leafy branches The tree is found in Tennasserim, Mergui, Malacca, Malay Islands, and Australia. The var *leucadendron* Duthie

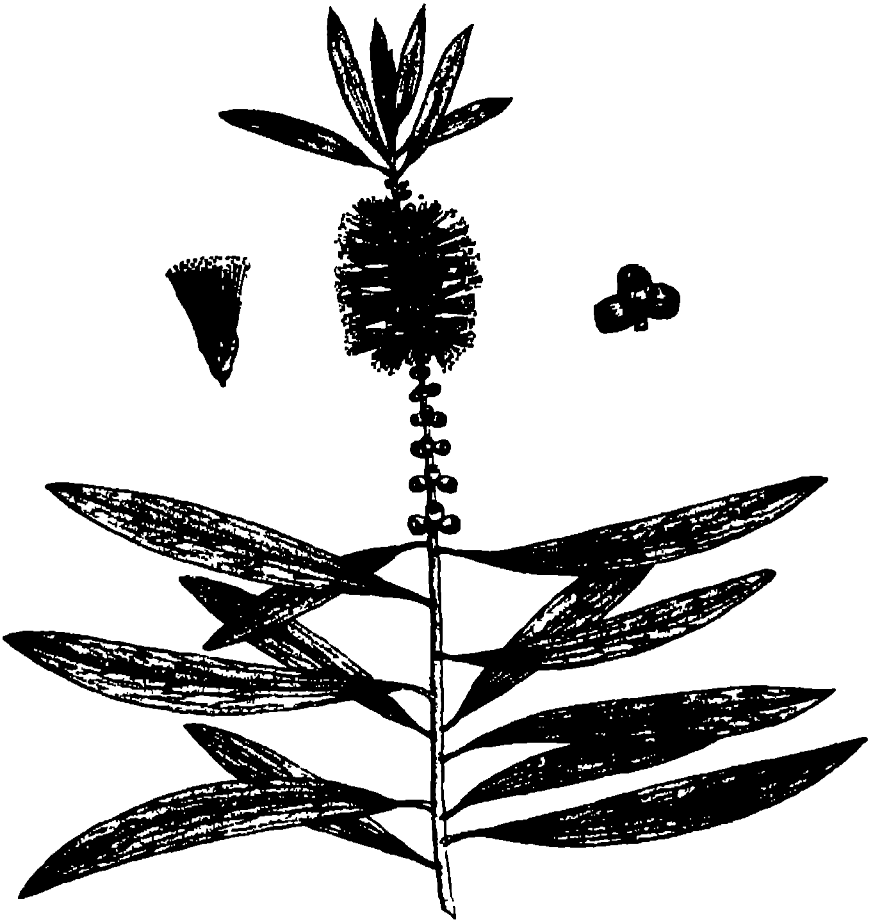

Fig 49 — *Melaleuca leucadendron* Linn

with glabrous spikes is cultivated in India It is a much larger tree than the var ***minor*** Duthie with villous spikes

The variability of the tree is confined not only to the stature of the tree, but it also extends to the amount of the essential oil in the leaves. These differences have not, however, yet been adequately investigated The wood is used as firewood, and, being durable in contact with wet ground and sea water, is considered useful for posts, piles, and shipbuilding

The cajuput oil of commerce appears to be distilled chiefly from the leaves of the var ***minor*** (referred to by some botanists as a distinct species, *M* ***minor*** Sm), although it has been stated to be obtained from *M* ***leucadendron*** and other species of this genus According to Finnemore, an oil called " cajoe-poeli " was imported into Europe from the East about the beginning of the seventeenth century This was later called cajuput The oil industry which now exists in the island of Buru (Molucca Islands), where the tree is abundant, began as a commercial undertaking in the first part of the nineteenth century, though previously the oil reached Europe in very small quantities and very irregularly The amount of oil present in the leaves is said to be greater in a rather dry climate Further, the young leaves are said to yield greater amount of oil than the older ones This oil is not distilled in India, but the following account given by Finnemore shows how it is recovered in Buru, the principal producer of the oil —

" The distilling apparatus employed in Buru is extremely primitive A barrel with open bottom is placed in a large, round, cast-iron basin, which is placed upon a hearth of fire-proof clay On the top of the barrel is fixed a wooden ring carrying a tin head-piece with a copper helmet From this the steam is led through zinc or copper tubes into the refrigerator, the distillate being run into gin bottles A hole about 7 mm in diameter is made just above the bottom of the bottle, which is placed in a vessel nearly as high as itself The leaves are stamped into the barrel so as to form a compact mass Water is poured on and sometimes petroleum as an adulterant If water is abundant, as when the still is erected near a river, a jet of water is used for cooling, but if it be scarce, it is renewed only for every charge, and loss of oil results When the distillation begins, the water stands only a little higher than the hole in the receiving bottle, and as the process continues, the water rises slowly inside and outside the bottle, being allowed to flow over until the receiver is almost filled with oil The green colour of the oil is often intensified by throwing copper coins into it "

The green colour of the oil is due to the presence of copper and can readily be removed by shaking with a weak solution either of tartaric acid or potassium ferrocyanide

The commercial cajuput oil has sp gr 0 919 to 0 930, n 1 4650 to 1 4710, $[\alpha] -1°$ to $-5°$, and cineole content 45 to 55 per cent Apart from cineole other constituents are *l*-α-pinene, *l*-limonene, benzaldehyde, butyraldehyde, valeraldehyde, terpineol and its acetic, butyric and valeric esters, and a sesquiterpene All these are present in small quantities (Finnemore)

According to B P (1932), oil of cajuput should be a colourless or yellow liquid, with an agreeable, camphoraceous odour, and a bitter, aromatic, camphoraceous taste It should contain not less than 50 per cent and not more than 60 per cent w/w of cineole Its sp gr should be 0 916 to 0 926, $[\alpha]$ not greater than $-4°$, and $n^{20°}$ 1 462 to 1 472 It should be soluble in 2 volumes of 80 per cent alcohol, the solubility becoming less with age According to the 1936 addendum to the 1932 B P. the limits for the refractive index have been fixed at 1 464 to 1 472 and cineole percentage between 50 to 65 Hence only rectified cajuput oil is official

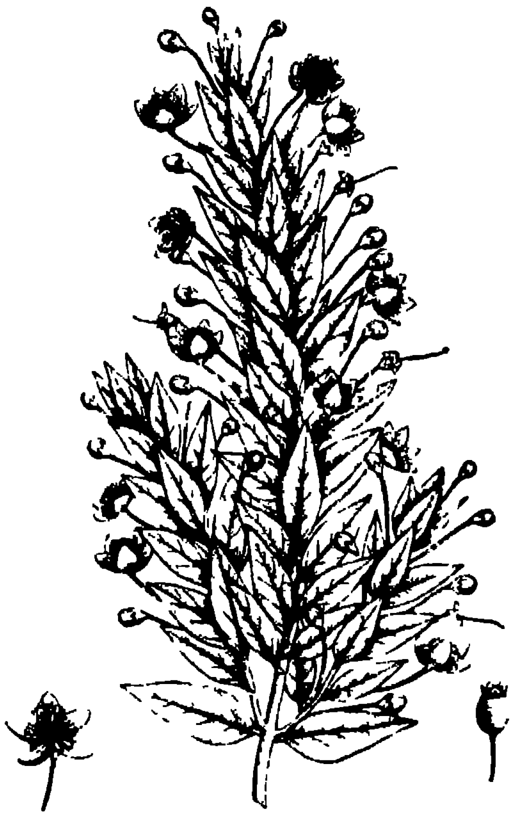

FIG 50 — *Myrtus communis* Linn

Cajuput oil is usually adulterated with that of eucalyptus oil, but petroleum has also been reported as an adulterant

The Dutch East Indies exported about 65 tons of cajuput oil in 1937 (Schimmel & Co, 1938 *Ann Rep* p 7), whereas larger amounts were exported during the previous years The decline in the export trade is due to the competition of Australian eucalyptus oils with a cineole content of over 70 per cent, as against the cineole content of 50 to 65 per cent in cajuput oil (Schimmel & Co, 1937 *Ann Rep* p 8)

Cajuput oil has the typical action of a volatile oil and is antispasmodic and carminative It is an intestinal antiseptic and has been given internally in chronic rheumatism due to intestinal toxaemia It is excreted by the bronchi, and is employed as an antiseptic in the treatment of phthisis

Externally, it acts as a stimulant and mild counterirritant It is applied to inflamed and rheumatic joints, diluted with 2 parts of olive oil or turpentine liniment The oil is also an excellent mosquito repellant, and has the advantage over oil of citronella in that it volatilizes more slowly

6 MYRTUS (Tourn) Linn

(The Latin name of myrtle, the Greek *myrtos* perfume referring to their aroma)

The genus comprises 70 tropical and subtropical species chiefly of S American shrubs, but is represented throughout the world Its members are characterized by opposite, gland-dotted leaves, and white or yellowish flowers in the axils A few S American species, such as *M luma* Barn, yield edible berries The common European myrtle (*M. communis* Linn) is cultivated in India, and is described below in detail.

Myrtus communis Linn

Fl Brit Ind, **II**, 462 (without description)

(Myrtle, *Vilayati-mehndi*)

This is an evergreen shrub with ovate to lanceolate, pellucid punctate, very sweet-smelling leaves, white, usually solitary flowers about ½ in in diameter, and black berries It is indigenous to the area extending from the Mediterranean region to Afghanistan and Baluchistan, and is commonly cultivated in Indian gardens, especially in the more temperate regions

The leaves, flowers and berries are used in perfumery and as a condiment, and the beautifully mottled wood is used in turnery. The fixed oil from berries is believed to strengthen and promote the growth of hair The leaves and berries are also accredited with medicinal properties, and are used locally

The essential oil from the leaves, known as myrtle oil, is a yellow or greenish-yellow oil of fragrant and refreshing odour It is obtained in a yield of about 0 3 per cent, and is a useful constituent of Eastern bouquets for certain soaps The oil, however, varies greatly according to the country of origin The commercial oil is mostly of French and Spanish origin Schimmel & Co in their reports (April, 1909 p 71, April, 1910 p 78, October, 1911 p 61, April, 1912 p 94, and April, 1914 p 70) give the following characteristics of the oil from different countries —

COUNTRY	SP GR 15°	[α]	$n^{20°}$	ACID VAL	ESTER VAL	ESTER VAL AFTER ACETYLATION	SOLUBILITY
France	0 890 to 0 904	+11° to +25°	1 464 to 1 468	Up to 1 5	10 to 28	38 to 58	In 0 5 volume of 90 per cent alcohol the majority in 5 to 10 volumes of 80 per cent alcohol
Spain	0 913 to 0 925	+22° to +25°	1 467 to 1 470	Up to 1 7	68 to 86	103 to 117	In 1 to 2 rarely up to 5 volumes of 80 per cent alcohol
Corsica	0 882 to 0 887	+22° to +27°	1 464 to 1 470	1 0 to 1 6	13 0 to 25 0	30 2 to 38 5	In 0 8 to 2 5 volumes of 90 per cent alcohol
Syria	0 893 to 0 922	+11° to +20°	1 463 to 1 468	1 9	18 to 31	70 7 to 72 0	In 1 to 5 volumes of 80 per cent alcohol
Asia Minor	0 913	+10 42	1 467	1 5	30 4	94 9	In 0 9 volume of 80 per cent alcohol
Cyprus	0 917 to 0 930	+8 11'	1 461	0 1	20 9	63 9	In 1 volume and more of 80 per cent alcohol
Dalmatia	0 925	+13 2	1 466	1 0	134 8	186 7	In 3 2 volumes and more of 70 per cent alcohol
Algeria	0 881 to 0 887	+25 52' to +27 10'	1 464	1 1	17 to 20 6	39 2	In 0 5 volume and more of 90 per cent alcohol

The constituents of the oil are pinene, camphene, dipentene, cineole, geraniol, nerol, and myrtenol Myrtenol is an alcohol of the formula $C_{10}H_{16}O$, and has the following characteristics b p 224°, sp gr $^{20°}$ 0 9763, [α] +45 45°, and *n* 1 4967 It is present mostly in the form of its acetic ester (Parry)

Pellini & Morani (1923 *Ann Chim. appl, Roma*, **13** 97), working with Sicilian leaves and stems (bearing flowers and fruits), obtained a yield of 0 112 to 0 22 per cent. of the oil This oil contained 29 1 to 46 3 per cent myrtenyl acetate and 5 9 to 14·1 per cent free alcohols as myrtenol On saponification, the oil gave cineole, myrtenol, and another unidentified alcohol The total amount of myrtenol corresponded to 20 per cent. of the original oil and 50 per cent of the total alcohols. Aldehydes were also present to an extent of 1.8 per cent.

The flowers on distillation yield a perfume called eau d'ange (1897. *Imperial Dictionary of English Language*, **5**, 223). According to Raybaud (1834. *J. de Pharm.*, **20**, 174, *vide* Wehmer), the fruits also contain an essential oil.

7. PIMENTA Lindl.

(From the Spanish *pimienta* — pepper, referring to the fruit of a species which is used as a spice)

This is a small genus comprising 5 tropical American and West Indian aromatic trees having large, leathery feather-veined leaves which are black-dotted beneath, small white flowers in cymes, and 1- to 2-seeded drupes. In India it is represented by one species, *P. officinalis* Lindl., which is cultivated in gardens. The unripe fruit of this species, when rapidly dried, forms the allspice or Jamaica pepper of commerce. This is described later in detail.

Another species, *P. acris* Kostel. (Jamaica bayberry, wild clove) of West Indies, furnishes from its leaves 1 to 1.5 per cent of an essential oil known as bay oil or oil of myrcia, which is used in perfumery and in the preparation of bay rum. The oil is distilled into water, when it separates into two portions — a light fraction, distilling over rapidly, and a heavy fraction, distilling more slowly, the former floating over the top of the water, the latter sinking. These are mixed together to get the normal commercial oil. According to Collens & Warneford (1927. *Perfum. essent. Oil Rec.*, **18**, 64), live steam gives a higher yield of the oil than is obtained by simply boiling the leaves with water. Oil of bay is a yellow liquid which rapidly becomes brown on exposure to the air. It has a pleasant, characteristic phenolic odour and a sharp, spicy taste. Its principal constituent is eugenol and its methyl ether. Myrcene, chavicol, methylchavicol, *l*-phellandrene, and citral are also present. It is an indispensable constituent of bay rum, which is used as a wash for the hair and as an astringent application to the face after shaving. When used in soap perfumes it gives an extraordinary feeling of freshness to the user. In traces it is of value in the preparation of carnation oils. Marketable bay oil should contain 40 to 50 per cent of phenols.

The quality of bay oil of commerce is not always uniform. This is due primarily to the fact that the leaves of several varieties (perhaps even different species), which are difficult to diagnose morphologically, are distilled along with the genuine leaves. In particular, if the leaves of the variety *citrifolia* (*P. citrifolia* Kostel.) got mixed with those of the genuine bay leaves, an inferior oil would be produced. The leaves of this variety can be distinguished by their odour, which recalls that of a mixture of bay and lemon oils (Poucher).

Pimenta officinalis Lindl.

(Allspice Tree, Jamaica Pepper Tree,
Pimento Tree)

This is a bushy evergreen tree 20 to 30 ft high, with aromatic, gland-dotted leaves and small, white, fragrant flowers. The fruit is a black or purple, 2-seeded berry, about the size of a pea. The tree is a native of the West Indies and tropical America. It is cultivated in Mexico for the export of its fruit, but the Mexican product is larger than the Jamaican allspice and inferior in quality. In India it is cultivated only in gardens, especially in Bengal, Bihar, and Orissa.

Most of the Jamaican supply of allspice comes from trees growing wild. Where cultivation is desired the tree is raised from the seed. The seedlings, when ready, are planted 20 ft apart. The soil may be poor, but it should be fairly light and well-drained. The tree commences to flower when it is 7 to 10 years old. The crop of berries increases till the tree attains an age of 18 to 20 years. Thereafter, it continues to bear fruit well for a long time. Some of the trees do not bear fruit, and these are called "male" trees. But this should not be understood to mean that the trees are unisexual. They are only sterile trees which occur abundantly with fertile ones. The cause of this sterility is not yet known (Ridley, 1912. *Spices*, p. 197).

In Jamaica, the saplings of the tree are highly prized for making walking sticks and umbrella sticks.

The unripe berries of this species, when rapidly dried, form the allspice of commerce.

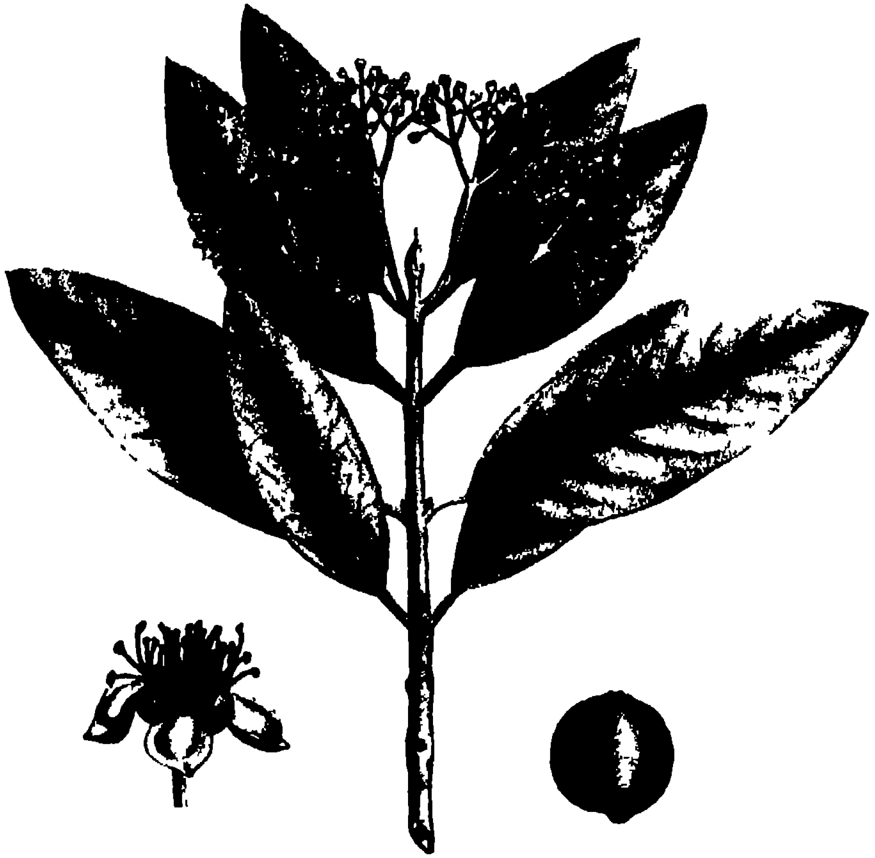

Fig 51 *Pimenta officinalis* Lindl

They are picked when fully grown but still green The ripe and undersized ones are discarded, and the desirable ones dried in the sun for 6 to 10 days During this period they become wrinkled and the colour changes to a dark reddish brown The berries have an aromatic taste and smell which is considered to resemble a mixture of the spices cinnamon, cloves, and nutmegs — hence the name allspice The flavour is contained in the pericarp, the seeds being not nearly as aromatic or pungent The seeds have a slight nutty flavour

Allspice is extensively used as a culinary spice It is also used in medicine as an aromatic stimulant and carminative, resembling clove in its action The essential oil distilled from it is used in medicine as a carminative and as an adjuvant to aperient medicines It is also used a little in perfumery for modifying the odour of carnation oils In the soap industry it is used for making several pleasant recipes by the replacement of clove oil

Although grown to some extent in all American tropics, allspice is so abundant in Jamaica that the island has a virtual monopoly, exporting before 1937 from 4,000 to 5,000 tons annually (Hill, 1937 *Economic Botany* p 474) In 1939, the exports amounted to about 3,600 tons valued at £207,073 f o b Due to the war, the exports from Jamaica fell to about half or less of this quantity in 1941 and 1942 (Parry, 1945. *Spice Handbook* p 21) According to Burkill (1935 *Dictionary of the Economic*

Products of Malay Peninsula, **2**. 1727), there are no markets in the world able to absorb a greater production than Jamaica supplies without cultivation

The unripe berries yield on distillation 3 to 4 5 per cent of an yellow or yellowish-red essential oil, which gradually becomes darker on keeping It has the characteristic odour of the fruit, and a pungent, spicy taste Its characteristics, according to the Chemists' Year Book, 1944, are sp gr $^{15^\circ}$ 1 025 to 1 055, $[\alpha]^{30^\circ}$ 0° to – 5°, n^{25° 1 525 to 1 535, eugenol content 60 to 80 per cent, and solubility 1 in 2 parts of 70 per cent alcohol Besides eugenol, its principal constituent, the oil contains [Schimmel & Co, 1904 (April) *Report* p 75] eugenol methyl ether (9 6 per cent), cineole, *l*-α-phellandrene, and caryophyllene, sesquiterpene and palmitic acid have also been reported

Jamaica exported nearly 15 tons of the oil to the U S A in 1945 (Schimmel & Co, 1945 *Ann Rep* p 48).

The leaves also yield an essential oil to the extent of 0 8 to 1 25 per cent (Finnemore). A yield of 2 9 per cent of oil on dry leaves has also been recorded (Anon, 1919 *Bull imp Inst, Lond*, **17** 297) In distillation, the use of dry steam under pressure is said to be the best method (Campbell, 1922 *Perfum essent Oil Rec*, **13** 389) Like the oil from the berries the leaf oil too is rich in eugenol, which is sometimes present to the extent of 97 per cent (Kemp, 1925 *Arch Pharm, Berl*, **263** 12, Campbell, 1923 *Perfum essent Oil Rec*, **14** 338), but may be as low as 32 per cent, although it usually varies from 61 to 93 per cent (Finnemore) The other constituents are caryophyllene and small amounts of an aldehyde, a ketone, and two acids (Kemp, 1925 *Arch Pharm, Berl*, **263** · 12) The constants of the oil are more or less similar to those of the oil from the fruit (Finnemore) The value of the oil depends upon the possibility of its competing with clove oil as a source of eugenol for the manufacture of vanillin, but, comparatively, the yield is smaller and eugenol content lower

The bark, too, is said to yield a small quantity of an essential oil (Wehmer)

8. PSIDIUM Linn

(Said to be derived from the Greek word *psidion* a name of some plant)

This genus comprises 110 species of tropical American and West Indian trees or shrubs having pubescent leaves, broad calyx tube, and a 4- to 5-celled ovary which in fruit becomes a pulpy, many-seeded berry

Many species yield edible fruits, e g, *P guajava* Linn (guâva), which has become completely naturalized in India The barks of some are known to contain tannins

Psidium guajava Linn

P guyava Linn, Fl Brit Ind, **II**, 468

(Guava, *Amrud*)

This is a large shrub or a small tree with ovate or oblong, minutely pellucid-dotted, faintly aromatic leaves and large white flowers Duthie in the *Flora of British India* distinguishes two varieties, viz, 1 var. *pyriferum* (Linn) Duthie with 1-flowered peduncles and pyriform fruits and 2 var *pomiferum* (Linn) Duthie with usually 2- to 3-flowered peduncles and globose or ovoid fruits. The fruits are 2 in or more long The plant was introduced from America, and is now cultivated and occasionally found semi-wild all over India The tree fruits sometimes in the second year, but certainly by the fourth, and it lives for about 40 years.

The guava, which is a sweet, juicy, and highly flavoured fruit with a fine balance between the contents of acid, sugar, and pectin, is highly prized as a fresh fruit and for making jellies, preserves, and pastes It is a rich source of vitamin C and pectin.

The leaves contain 0 09 to 0 36 per cent of an yellow, faintly aromatic essential oil [Peckolt, 1903 *Ber dtsch pharm Ges*, **13** 346, Altan, 1905 *Chem & Drugg*, **66**: 14, Altan, 1905 *J chem Soc* (*Abstr*), **88**(2) 192] The oil has the following characteristics sp gr $^{15^\circ}$ 0 9157, n^{20° 1 4964, $[\alpha]$ – 10 5°, saponification val 2 0, ester val 6 4, and soluble in about 10 parts of 90 per cent alcohol [Schimmel & Co, 1910 (April) *Report* p 124] Eugenol is present in the oil (Altan, *loc cit*)

The oil needs reinvestigation.

Supplement

AROMATIC PLANTS OF INDIA

PART XIV

BY

S. KRISHNA & R. L. BADHWAR

FOREST RESEARCH INSTITUTE, DEHRA DUN

FAMILY

47 Lecythidaceae
48 Lythraceae
49. Sonneratiaceae
50 Passifloraceae
51 Caricaceae
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53 Begoniaceae

Journal of Scientific & Industrial Research, Delhi
1950, Vol. IX, No. 4 (Pages 237-244)

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Family XLVII — LECYTHIDACEAE*

(Sapucaia-nut Family)

THIS family comprises 18 genera and 150 species of tropical trees Its members have the characters of Myrtaceae, but are without oil glands in the leaves, flowers, etc The leaves are alternate and usually crowded towards the ends of the branchlets The fruit is a berry or is fibrous, or in exotic genera woody and opening by a stoppel

The Indian species belonging to this family are of little economic importance, but those of S America are a potential source of timber supply because of their gigantic size The Colombian mahogany (*Cariniana priformis* Miers), however, is the only timber from this family which has figured to any extent to date in the world's trade The edible Brazil nuts of commerce (also called cream nuts or niggertoes) are obtained from *Bertholletia excelsa* Humb & Bonpl of S America They are collected to the extent of over 17,000 tons annually from the wild trees, and most of them are exported to Europe and the U S A Similar nuts of finer quality and more delicate flavour are obtained from the sapucaia-nut or paradise-nut tree (*Lecythis zabucajo* Aubl and *L ollaria* Linn) The sapucaia nuts are contained in a curious woody capsule (monkeypot) with a woody lid The fruit of the West Indian tree *Grias cauliflora* Linn is the anchovy pear, which is cultivated in the West Indies and eaten, often as a pickle Some species belonging to the genera *Careya* and *Barringtonia* are used as fish poisons Some plants, such as *Napoleona imperialis* Beauv and *Couroupita guianensis* Aubl (cannon-ball tree) bear ornamental flowers, and are cultivated in Indian gardens

Seeds of this family yield fatty oils, while saponins and tannins have also been reported from several species

The family is of little importance from point of view of essential oils The cream or white, 2½ to 4 in wide flowers of *Careya arborea* Roxb (wild guava), a medium-sized tree of the Sub-Himalayan tract, Bengal, Central, Western and Southern India, have an unpleasant smell According to Watt the fruit of this plant, too, is aromatic, and the calyx, if placed in water, becomes coated with mucilage and emits a sickly odour This is probably due to putrefaction

The large, woody, globose fruit (known as cannon ball) of *Couroupita guianensis* Aubl of Indian gardens has an extremely unpleasant smell when ripe

BARRINGTONIA Forst

(After Daines *Barrington*, 1727 – 1800, English judge and naturalist)

This genus comprises about 30 tropical trees, out of which 4 are found in India Most of its members contain saponins, and, therefore, they are used as fish poisons The saponin is found in the largest amount in the seeds, but the barks of some species also contain this to a fair extent The woods of some species are useful, and the seeds of some yield fatty oil

B acutangula (Linn) Gaertn (Indian oak, *samudra-phal*), a small or medium-sized tree found in the coastal regions of India, particularly in Bengal, S India and the Andamans (also cultivated in gardens for ornamental purposes), bears pink, ½ in across, delicately fragrant flowers which are borne in long drooping racemes often 1 ft or more long

According to Gildemeister & Hoffmann, the essential oil from the Javanese *B spicata* Blume contains methyl salicylate, but the present authors have not been able to trace any original reference for this statement.

Barringtonia asiatica (Linn) Kurz

B speciosa Forst., Fl Brit. Ind , II, 507

(*Samudra-phal*)

This is a rather small or medium-sized tree 30 to 50 ft high, with large obovate

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* The Lecythidaceae is included in the family Myrtaceae in the *Flora of British India*

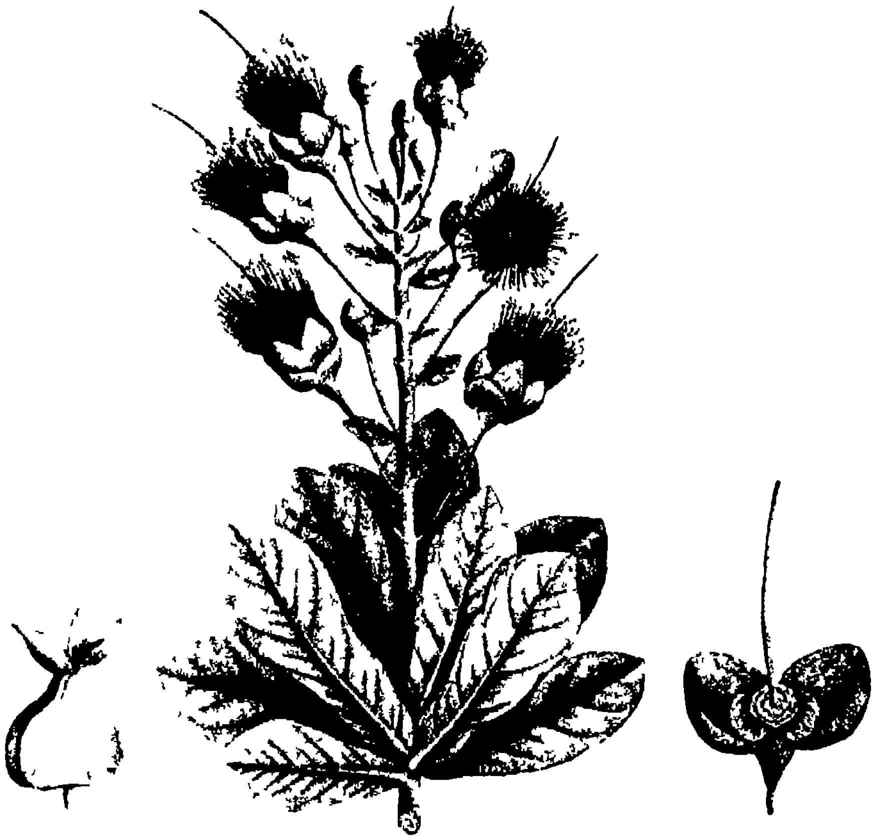

FIG 52 — *Barringtonia asiatica* (Linn) Kurz

leaves often 15 by 7 in The flowers, which are ¾ in in diameter, are arranged on short erect racemes, and the fruit is 3 by 3 in, quadrangular or nearly ovoid It is a native of the Andaman Islands, Singapore, and Ceylon, it also occurs in the Southern Deccan Peninsula, but probably not in a wild state

The bark, fruit, and seed of this plant are said to be used to poison fishes

The bark is stated to contain a resin and a volatile oil (Watt) The seeds contain 3 27 per cent of the glycosidic saponin barringtonin and 1 per cent of a substance designated as barringtogenitin (Wehmer).

Family XLVIII — LYTHRACEAE *

(Loosestrife and Henna Family)

This family comprises about 21 genera and 500 species of herbs, shrubs or trees, which are found in all zones except the frigid ones Its members usually have opposite, simple, entire leaves, often showy flowers with valvate sepals, free ovary, and capsular, many-seeded fruits.

The family is not of any great economic importance From point of view of timber, several species of *Lagerstroemia*, particularly

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* The Lythraceae, as understood in this work, is exclusive of the families Punicaceae, Sonneratiaceae, and Oliniaceae

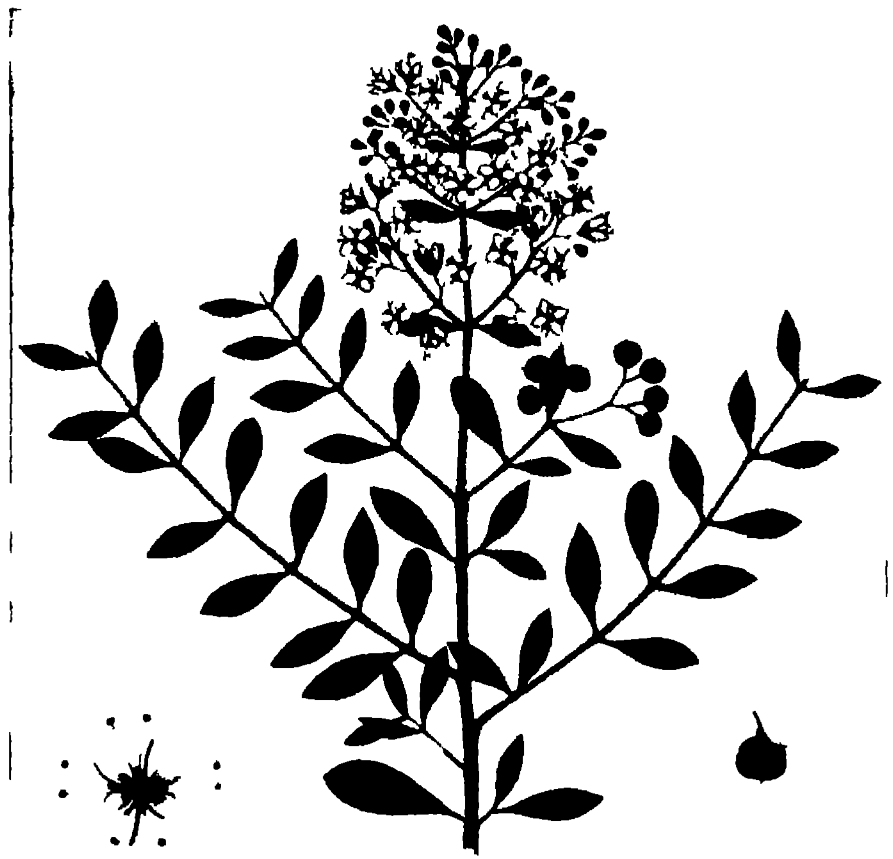

FIG 53 Lawsonia inermis Linn

L speciosa (Linn) Pers (*L flos reginae* Retz) are the most important members *Lagerstroemia speciosa* *L* *indica* Linn (Indian lilac) and species of *Woodfordia* and ***Cuphea*** are extensively grown as ornamental plants Several species of *Lawsonia* *Woodfordia* and the American genus *Lafoensia* are the sources of vegetable dyes The leaves of henna (*Lawsonia inermis* Linn syn *L* *alba* Lam) an ornamental and fragrant shrub are widely used in the Orient for tinting the nails palms and hair Plants used in indigenous medicine possess astringent acrid emetic cathartic or diuretic properties

Some species contain essential oils and that from the flowers of *Lawsonia inermis* is distilled to an extent in India Geraniol is the only constituent which has been reported from the essential oils of this family It is said to have been obtained from *Physocalymma scaberrimum* Pohl which is known as the Brazilian rosewood oil

Lagerstroemia parviflora Roxb (*lendi*) a large to medium sized tree found almost all over India except the very dry regions bears ¼ to ½ in across (according to the varieties) white fragrant flowers in panicles The Burmese *L* *villosa* Wall *ex* Kurz also bears white slightly scented flowers

LAWSONIA Linn

(In honour of John Lawson M D a Scottish naturalist and author of *A New Voyage to Carolina* 1709)

This genus consists of one species *L* *inermis* Linn (*L* *alba* Lam) which is described below

Lawsonia inermis Linn

L alba Lam Fl Brit Ind, II, 573

(Henna, *Mehndi*)

This is an Old World tropical shrub about 6 ft high, with opposite leaves, and large, terminal, pyramidal panicles of sweet-scented, white or pinkish flowers about ¼ in in diameter The fruit is a capsule of the size of a pea

The shrub is commonly cultivated in India often as a hedge plant and for the sake of its dye-yielding leaves and scented flowers, perhaps wild on the Coromandel coast and in the Deccan The leaves are used for tinting nails, palms, and hair a carroty-red colour

Henna has been used in Egypt to dye the hands since ancient times, it was also used in the preparation of mummies According to Pliny, the port of Canopus, at the western side of the Nile delta, was full of these bushes which scented the town when in flower, and the flowers were used in perfumery According to Watt, Olivier states that a fragrant water distilled from the flowers was known to the Jews, and was employed in baths and in religious ceremonies The ancient Egyptians also made a similar use of the flowers for the purpose of perfuming the oils and ointments

The leaves of this plant are used not only as a cosmetic, but also in indigenous medicine for a variety of purposes

The flowers yield on distillation a fragrant otto called *mehndi* The distillation is said to be practised in Banaras and Lucknow The odour of the essential oil, according to Burkill (1935 *Dictionary of the Economic Products of the Malay Peninsula*, **2** 1323), resembles that of the tea rose, and also suggests mignonette According to Poucher, the flowers exhale an odour recalling lilac

Holmes [1880 *Pharm J*, **10**(3) 635] prepared an essential oil from the flowers, but its constants and chemical composition do not appear to have been reported

By extraction of the dried flowers with benzene or alcohol, a resinoid is obtained, it has a very agreeable odour, somewhat phenolic and very tenacious (Naves & Mazuyer, 1947 *Natural Perfume Materials* p 272)

Family XLIX — SONNERATIACEAE *

(Sonneratia Family)

This family comprises 3 genera and 12 species of shrubs and trees, which are found in tropical Asia and Africa Its members have opposite leaves, large flowers with indefinite stamens, and pulpy, often edible, fruit

The family is an unimportant one from the economic point of view, except that some species furnish useful wood for local purposes

Duabanga sonneratioides Buch -Ham, a tall handsome tree of the Sub-Himalayan tract from Nepal eastwards to Assam, Khasi Hills, Manipur, Chittagong, and the Andamans, bears 2 to 3 in wide flowers, which have an unpleasant smell It has drooping branchlets owing to the weight of terminal corymbs of flowers

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* The Sonneratiaceae is included in Lythraceae in the *Flora of British India*

Family L — PASSIFLORACEAE *

(Passionflower Family)

This family comprises 18 genera and 380 species of herbs or shrubs of tropical and warm temperate regions Its members are usually climbing by means of tendrils or rarely twining, and have mostly showy flowers distinguished chiefly by the fringed corona on the throat of the calyx The fruit is a berry or a capsule

This family is hardly of any economic importance The square-stalked passionflower or common granadilla (*Passiflora quadrangularis* Linn) is cultivated in hotter parts of India for its flower and sweet acid fruit which are much esteemed The fruit of *P edulis* Sims (passion fruit) which is of the size of a hen's egg, is edible The plant is sometimes cultivated in the hills and has 3-lobed, toothed leaves Some species of *Adenia* are accredited with poisonous properties Most of the plants of the genus *Passiflora* contain hydrocyanic acid

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* The Caricaceae, which is included in this family in the *Flora of British India*, is dealt with separately in this work

No essential oil appears to have been isolated from plants belonging to this family The smell of the foliage of ***Passiflora foetida*** Linn , a slender climber widely grown in Indian gardens and sometimes found wild near towns, is foetid, especially when bruised, and is enough to prevent animals from eating it The plant is at once recognized by the moss-like pectinate involucre of leaves

Family LI — CARICACEAE*

(Papaw Family)

This is a small family comprising 4 genera and 40 species of tropical trees Its members have a milky juice, dioecious flowers, and fleshy baccate fruits

The family includes the genus *Carica* whose milky juice is rich in the proteolytic enzyme papain, a valuable medicine Some plants contain the alkaloid carpaine and the glycoside carposide

CARICA Linn

(Named from an erroneous idea that it was a native of *Caria*)

The genus comprises 30 species of chiefly tropical American half-woody trees *C papaya* Linn , which yields the well-known papaya or papaw fruit, is being cultivated in most warm countries, and is described below *C candamarcensis* Hook *f* (*C cundinamarcensis* J Linden), which yields a smaller but sweeter fruit (mountain papaw), has been cultivated in some tropical mountains , it is a montane plant

Carica papaya Linn

Fl Brit Ind **II**, 599 (without description)

(Papaw, Papaya)

This is a well-known small, soft-wooded, short-lived tree with numerous leaf-scars on the stem The leaves are very large and like the palm of the hand The flowers are pale yellow fragrant generally dioecious, but occasionally there are a few bisexual flowers on the male plant The fruit is succulent, indehiscent, 1-celled, of the size of a melon with soft yellow pulp, and the seeds blackish covered with a loose hyaline skin or arillus It is largely cultivated in Bombay, Bangalore, Bihar Bengal, Dehra Dun, etc , for the sake of its luscious fruits It does not grow well in the drier parts of India but flourishes where rainfall is high and the climate hot

The seeds yield on distillation an essential oil containing sulphur and nitrogenous compounds (Wehmer) This essential oil appears to be derived from the hydrolysis of a glycoside through the action of a ferment, in the same way as the volatile oil of mustard (Burkill, 1935 *Dictionary of the Economic Products of the Malay Peninsula*, **1** 454) The roots also contain the glycoside (Burkill, *loc cit*)

No essential oil is reported to have been extracted from the flowers

---

* The Caricaceae is included in Passifloraceae in the *Flora of British India*

Family LII — CUCURBITACEAE

(Gourd Family)

This family comprises 90 genera and about 750 species of chiefly herbaceous, tendril-bearing vines, which are most abundant in the tropics The flowers are yellow or white, dioecious or monoecious, and the fruit is usually a berry, like the melon or cucumber

The leaves and stems of a number of species, particularly when crushed, emit a nauseating, cucurbitaceous odour The fruits of some also possess a similar odour

A number of plants of this family yield vegetables and fruits which are in common use Some of the more important of these are *palval* (*Trichosanthes dioica* Roxb), *lauki* or bottle gourd (*Lagenaria vulgaris* Ser), *ghia-tori* or sponge gourd [*Luffa cylindrica* (Linn) M Roem, syn *L aegyptiaca* Mill *ex* Hook *f*], *petha* or white gourd-melon [*Benincasa hispida* (Thunb) Cogn, syn *B cerifera* Savi], *karela* or carilla fruit (*Momordica charantia* Linn), *kharbuza* or sweet melon (*Cucumis melo* Linn), *khira* or cucumber (*C sativus* Linn), *kumra* or squash gourd (*Cucurbita maxima* Duchesne), *kaddu* or pumpkin (*C pepo* Linn), *tarbuz* or watermelon (*Citrullus vulgaris* Schrad *ex* Eckl & Zeyh), etc It is curious that all the above species when in the wild state are stated to contain toxic bitter substances

Some plants yield valuable drugs, and a few are cultivated for ornamental purposes The fruit pulp of colocynth [*Citrullus colocynthis* (Linn) Schrad] is commonly used as a purgative The foreign squirting cucumber [*Ecballium elaterium* (Linn) A Rich] and the roots of bryony of Europe (*Bryonia dioica* Jacq) have also purgative properties

Very few of the wild species of this family are edible, and the bitter "varieties" particularly must be eaten with great caution The fruits are often laxative, sometimes very bitter, strongly emetic, and cathartic The roots are occasionally acrid and act as drastic purgatives Some of the plants have anthelmintic and emmenagogue properties The seeds of almost all plants yield fatty oils, some of which are edible and some possess medicinal properties

Colocynth and roots of bryony have traces of an essential oil (Wehmer) Some of the important constituents isolated from plants of this family are (*a*) bitter substances, such as those found in *Cucumis*, *Ecballium*, *Lagenaria*, *Luffa*, *Momordica*, *Trichosanthes*, etc, (*b*) saponins as in *Citrullus*, *Cucumis*, *Cucurbita*, *Lagenaria*, *Luffa*, etc, (*c*) glycosides, such as brionine, and (*d*) alkaloidal principles, such as those found in *Bryonia* and *Citrullus*.

CUCUMIS (Tourn) Linn

(Etymology obscure)

The genus comprises about 25 tropical and subtropical species of yellow-flowered, climbing or trailing herbs with simple tendrils, and is represented in India by 3 species The cucumber (*C sativus* Linn) and the sweet melon (*C melo* Linn) are the most important species and are widely cultivated for their fruits The fruits of several foreign species, such as those of *C africanus* Linn *f** and *C myriocarpus* Naud are toxic

Cucumis sativus Linn

Fl Brit Ind, **II**, 620

(Cucumber, *Khira*)

This hispidly hairy climber is cultivated throughout India for the sake of its fruit — a well-known salad vegetable, also cooked and pickled The seeds are eaten and are also accredited with medicinal properties, they yield a fatty oil

The cucumber juice is used in the preparation of glycerine and cucumber hair creams This is obtained by expression from the fresh fruits After clarification, alcohol, benzoic or salicylic acid is added as a preservative (Poucher)

The peculiar odour of cucumber is also extracted with alcohol and used in blending certain bouquet perfumes The extract is prepared by macerating the peeled and thinly sliced fruit in warm alcohol If the odour is not sufficiently strong after a few days, the alcoholic extract is repeatedly poured over some more fresh slices, and the macerated residue is expressed At the end of the operation the extracts are filtered The excess of alcohol is removed and the cucumber concentrate obtained (Atkinson, 1915. *Perfumes & Cosmetics* p 162)

A perfume called *sasa atar* made from this plant is stated to have been exhibited in London as early as in 1881, at the Colonial or Indian Exhibition (Watt) It was presumably prepared from the fruit in a somewhat similar manner as the one described above.

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* The *Index Kewensis* cites Lindl *f* as the author of this plant. This is a misprint for Linn *f*

Family LIII — BEGONIACEAE

(Begonia Family)

This family comprises 5 genera and about 800 species of succulent herbs or rarely undershrubs which are found in all tropical moist countries, except Australia *Begonia* is the most important genus embracing about 750 species with thick rhizomes or tubers, more or less unequal-sided leaves, monoecious, usually showy flowers in dichotomous cymes, and winged capsules

The family is of little direct economic importance, except that many species of *Begonia* are highly ornamental and great favourites of the modern foliage cultivator Some species, such as *B minor* Jacq (*B nitida* Dryand), are also grown for the beauty of their flowers The most important species which have been hybridized for numerous beautiful-leaved horticultural varieties are the Indian *B rex* Putz and *B griffithii* Hook

The succulent stems of some begonias have a pleasant flavour, and are used as potherbs When fresh, they have a peculiar acid taste The leaves of some foreign species are also eaten

The juice of the ornamental *B rex* is poisonous to leeches, and may, therefore, be used to kill them when they are encountered in the nostrils of animals

Begonia roxburghii A DC of Khasi Hills, Konkan, and North and East Bengal is a stout, succulent plant which bears white or very pale pink fragrant flowers in short dichotomous few- or many-flowered cymes, its roots are fibrous (not tuberous)

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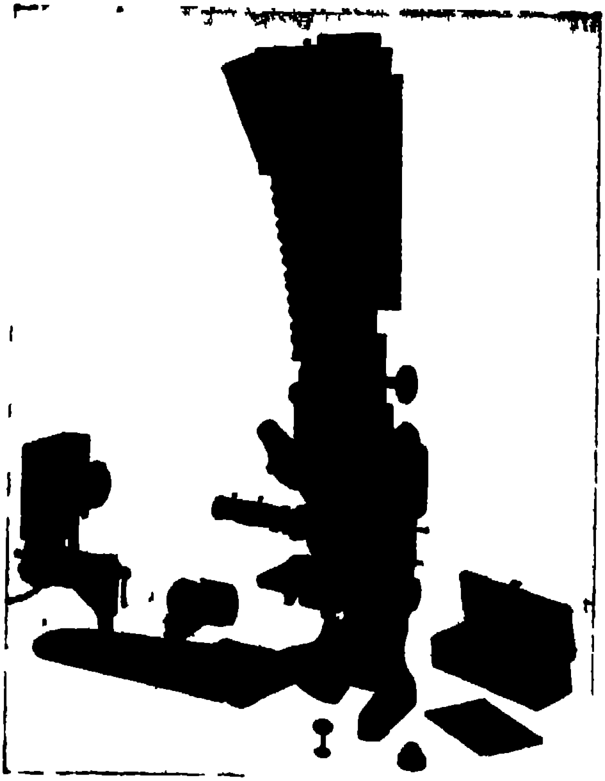

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Chemical Examination of the Roots of *Saussurea lappa*, Clarke — Part I: On the Reported Isolation of the Alkaloid "Saussurine"

KAILASH CHANDER SALOOJA, VISHWA NATH SHARMA & SALIMUZZAMAN SIDDIQUI

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The roots of the medicinal plant *Saussurea lappa* Clarke, have been investigated for their active principles. The basic fraction obtained by extracting the roots with ammoniacal alcohol has been characterized through its chloroplatinate, $C_{60}H_{[illegible]}O_8N_2H_2PtCl_6$, m p, 200°C A liquid constituent, b p 176°-78°C at 3 mm, $[\alpha]^{25}_{D} = +18\cdot1$, provisionally named *Kushtin*, $C_{15}H_{[illegible]}O_2$, has been isolated from an ether extract of the roots A comparison of the molecular formula of the chloroplatinate and that of the liquid constituent suggests that the parent base might have resulted through the interaction of ammonia with two molecules of the latter.

SAUSSUREA lappa, Clarke (Hindi — *Kustha, Kuth*) is a well known medicinal plant used in the indigenous system of medicine for the treatment of cough, asthma fever, dyspepsia, leprosy, and as a diuretic and anthelmintic It is also extensively used in China as a powerful stimulant, carminative and antispasmodic The best quality of the roots is obtained in Kashmir, from where they are exported in large quantities

Hooper[1] mentions the presence of one solid and two liquid resins in the roots and also traces of an alkaloid The essential oil from the roots was found by Semmler and Feldstein[2] to consist of aplotaxene, costol, dihydro-costus lactone, costus lactone, costic acid, α-costene and β-costene besides traces of phellandrene, terpene alcohol and camphene The therapeutic action of the essential oil was studied by Chopra and De[3,4] who noted that it is effective in controlling paroxyms of bronchial asthma Ghosh, Chatterjee and Dutta[5] have reported the isolation of an alkaloid " Saussurine " in the form of its tartarate from the alcoholic ammonia extract of the roots, but they have not given any physical or chemical data about the alkaloid

During the course of the present work which was primarily undertaken to study the alkaloidal constituents of the roots, it was observed that the alcoholic extractive from the powdered roots, with or without prior maceration with lime or alkali gave only a slight precipitate with the usual alkaloidal reagents, and on working up the alcoholic extract from 1 kg of the drug, it was not possible to isolate any alkaloid from it On the other hand, a repetition of Ghosh *et al* 's procedure for the isolation of " Saussurine " through extraction of the roots with ammoniacal alcohol and removal of the solvent at ordinary pressure without previous acidification, yielded a basic fraction which gave alkaloidal tests with Dragendorff's, Wagner's and Mayer's reagents Attempts to crystallize the basic fraction which is readily soluble in alcohol and methanol, less so in ether and chloroform, and sparingly soluble in water proved unsuccessful It failed to give any insoluble salt with the usual organic and inorganic acids, and attempts to prepare its tartarate in the manner described by Ghosh and co-workers gave only crystals of tartaric acid The basic fraction could, however, be characterized through its chloroplatinate, which was obtained in the form of a light-brown micro-crystalline powder melting at 200°C (decomp), and analysed for the molecular formula $C_{40}H_{54}O_5N_2\ H_2PtCl_6$ In view of these facts and the absence of any physical or chemical data in regard to "Saussurine", it was concluded that the product isolated by Ghosh and co-workers was a basic condensation product of certain constituent present in the drug with ammonia This view found further support from the fact that the ethereal extractive of the roots which was free of nitrogen, gives, on treatment with ammonia in the cold, a basic condensation product yielding a chloroplatinate identical in its melting point, solubilities and analysis with the one referred to above The alcoholic extractive of the drug which gave only slight precipitate with alkaloidal reagents also gave the same chloroplatinate from the nitrogen-containing basic condensation product obtained by the action of ammonia

In order to further investigate the constituents of the drug, it was extracted with ether, as the higher boiling solvents tended to produce high melting (m p above 350°C), amorphous, resinous products The concentrate from the ethereal extracts was repeatedly extracted with petroleum ether to separate the essential oils and fatty matter The petroleum ether insoluble residue, which failed to crystallize from the usual organic solvents, was subjected to fractional distillation under reduced pressure, when a pale-yellow liquid was finally obtained as the major fraction (b p 176°-78°C at 3 mm), which analysed for the molecular formula $C_{20}H_{26}O_3$ and has been provisionally named as "Kushtin" It is optically active, $[\alpha]_D^{28} = +18\ 1$ in chloroform solution It is insoluble in sodium bicarbonate or alkali and does not give any colouration with ferric chloride It does not reduce Fehling's solution Titrations with standard bromine solution showed the presence of one double bond in the molecule From the resultant solution a crystalline bromo derivative, m p 172°C (decomp), was obtained, which is under investigation

A comparison of the molecular formulae of the chloroplatinate ($C_{40}H_{54}O_5N_2\ H_2PtCl_6$) and that of the liquid constituent obtained above ($C_{20}H_{26}O_3$) would suggest that the parent base might have resulted through the interaction of ammonia with two molecules of the latter This point as well as further studies in the constitution of these products are in progress

Experimental

Examination of the Alcoholic Extracts — Alcoholic extracts of the powdered drug with and without previous maceration with 3 per cent alcoholic potash and slaked lime were extracted with 2 per cent hydrochloric acid and the acidic solutions tested after filtration with Dragendorff's, Wagner's and Mayer's reagents In all the three cases only faint precipitates were obtained

1 kg of the powdered drug was percolated with alcohol at the room temperature The percolates were concentrated under reduced pressure and the residue was extracted with 2 per cent hydrochloric acid The acidic solution was filtered, basified with dilute alkali and extracted with chloroform The chloroform solution was washed with water, dried over anhydrous sodium sulphate, filtered and freed of the solvent The oily residue did not give any precipitate with the alkaloidal reagents and failed to crystallize

Examination of the Ammoniacal Alcoholic Extract — 500 gm of powdered roots were extracted in the cold with 5 per cent ammoniacal alcohol Following the procedure adopted by Ghosh *et al*, the extract was freed of the solvent on the water bath at ordinary pressure without previous acidification The residue was repeatedly extracted with 1 per cent sulphuric acid, and the acidic solution was made slightly alkaline with ammonia and extracted with chloroform The chloroform solution was washed with water, dried over anhydrous sodium sulphate, filtered and freed of the solvent The basic residue gave thick precipitates with Dragendorff's, Wagner's and Mayer's reagents, and was soluble in alcohol and methanol, less so in ether and chloroform and sparingly soluble in water, and failed to crystallize from any of these solvents. It did not give any insoluble salt with various organic acids, viz oxalic acid, succinic acid, tartaric acid, etc, or with inorganic acids like hydrochloric acid and sulphuric acid Attempts to prepare the tartarate in the manner described by Ghosh and co-workers gave only crystals of tartaric acid A solution of the basic residue in dilute hydrochloric acid however gave a thick buff-coloured precipitate of chloroplatinate on the addition of a dilute solution of platinic chloride The precipitate was filtered washed with water and dried on a porous plate The chloroplatinate thus obtained formed a light brown micro crystalline powder which darkens from 175°C onwards and melts with decomposition at 200°C It is sparingly soluble in cold water more so in the hot and insoluble in common organic solvents Found after drying to constant weight at 100°C *in vacuo* over phosphorus pentoxide C 45 3 H 6 0 N 3 5 Pt 18 1 per cent $C_{40}H_{56}O_8N_2$ H_2PtCl_6 requires C 45 5 H 5 5 N 2 7 Pt 18 5 per cent

Treatment of the Ethereal Extract with Ammonia — 500 gm of the powdered roots were extracted with ether and dry ammonia was passed through the well cooled extract The ethereal solution was well washed with water and freed of the solvent The residue which gave thick precipitates with Dragendorff s Wagner s and Mayer s reagents was extracted repeatedly with dilute hydrochloric acid The acidic solution was basified and extracted with chloroform The chloroform solution was washed with water and evaporated on the water bath and the residue was dissolved in dilute hydrochloric acid The acidic solution gave a chloroplatinate on the addition of a 4 per cent solution of platinic chloride (yield 0 37 gm) The chloroplatinate showed the same melting point as the one obtained above by following the procedure of Ghosh *et al* and gave no depression in the melting point on admixture with it Its solubilities were also similar After drying to constant weight at 100°C *in vacuo* over phosphorus pentoxide it gave C 45 3 H 5 8 N 3 0 Pt 18 2 per cent $C_{40}H_{56}O_8N_2$ H_2PtCl_6 requires C 45 5 H 5 5 N 2 7 Pt 18 5 per cent

Treatment of the Alcoholic Extract with Ammonia — The alcoholic extract from 500 gm of powdered roots was saturated with dry ammonia and the reaction mixture was left overnight in the ice box The solution was evaporated on the water bath and finally *in vacuo* The residue gave copious precipitates with Dragendorff s Wagner s and Mayer s reagents It was extracted with dilute hydrochloric acid and the acid solution after basifying with dilute alkali was extracted with chloroform The chloroform solution was washed with water dried over anhydrous sodium sulphate and freed of the solvent when a dark brown treacly residue was obtained which could not be crystallized Its solution in dilute hydrochloric acid yielded a light brown micro crystalline chloroplatinate which gave no depression in the melting point on admixture with samples of the chloroplatinates obtained in the foregoing experiments After drying to constant weight at 100°C *in vacuo* over phosphorus pentoxide it gave C 44 9 H 5 6 N 2 9 Pt 18 1 per cent $C_{40}H_{56}O_8N_2$ H_2PtCl_6 requires C 45 5 H 5 5 N 2 7 Pt 18 5 per cent

Isolation of Kushtin from the Ether Extract — 500 gm of powdered roots were extracted with ether and the extract was freed of the solvent on the water bath and finally *in vacuo* The residue (33 4 gm) which was free of nitrogen was extracted repeatedly with petroleum ether The petroleum ether insoluble fraction (2 9 gm) which could not be crystallized from the usual organic solvents was subjected to fractional distillation at 3 mm pressure when Kushtin was finally obtained as a pale yellow thick liquid distilling at 176° 78°C It is soluble in ether ethyl acetate chloroform and benzene and sparingly so in alcohol methanol and petroleum ether It is insoluble in sodium bicarbonate or potassium hydroxide does not give any colouration with ferric chloride and does not reduce Fehling s solution In 1 per cent solution in chloroform it gave $[\alpha]_D^{8} = +18 1$ Found C 77 2 H 8 6 per cent and M W (after Rast) 312 $C_{20}H_{26}O_3$ requires C 77 0 H 8 3 per cent and M W 314

0 0265 gm of the substance in dry chloroform was titrated under ice cooling against 0 0906 per cent bromine solution in the same solvent After the addition of 15 2 c c of the bromine solution it was found to be in excess (Bromine solution required for one double bond 14 9 c c) The resultant solution was freed of the solvent at the room temperature The oily residue on crystallization from methanol yielded colourless needles of a bromo derivative melting at 172°C (decomp)

Acknowledgement

The authors take this opportunity to thank the Chief Conservator of Forests Government of Jammu and Kashmir for supplying a fresh authentic sample of the drug

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The Riboflavin Excreting Mutant & the Problem of Variability in Yeasts

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Artificially produced top yeasts excrete into the wash considerable amounts of riboflavin. The possibility that these may be highly useful for industrial exploitation necessitated a consideration of the problem of stability in yeasts.

Systematic observations of the changes in the sculpturing of the giant colonies of top yeasts extending over the years indicate only a waxing and waning of the size of the sculptured rim during the different seasons when cultured at the room temperature

The waxing and waning of the sculptured rim parallels the predominance of the rough and smooth types of colonies in the two-chromosome control. Since the top yeasts appear to be the result of a chromosomal translocation, the genic sequences should have been altered and as a result mutations at the loci governing the nature of sculpturing should produce phenotypic expressions entirely different from that observed in the control. Tetraploids are highly stable and hence types suitable for industry should be polyploids.

Introduction

THE recent discovery[1] that a top yeast, isolated by us[2] three years ago, gives not only a better yield, but excretes into the wash a considerable amount of riboflavin, led to the suggestion that the strain may be useful for compressed yeast manufacture As pointed out in a previous contribution[3] one of the important considerations to be kept in view is the stability of the strains The problem of stability has received scant attention and rather confusing statements are found in the literature on yeasts From his investigations on *Nadsonia*, Skovsted[4] concluded that reverse mutations do not occur and that "each type under fixed conditions produces a limited number of mutations only but where the mutants produce a number of new mutations" (p 451) This view is apparently that of Winge[5] also who considers that it is impracticable to keep a type unchanged except for short periods The appearance of minor mutations may change the original type considerably and when, after lapse of some time, one comes across a sector having an identical type of sculpturing as the original type at the start of the experiment, he believes that one cannot at all be sure that it is the original type

The Problem

The above conclusions, if accepted literally, raise other fundamental questions (1) If there is such variability, is it a general phenomenon affecting also the genes responsible for the specific biochemical behaviour of the various strains? If the answer is in the affirmative, then the classification of yeasts into species is not valid at all Winge and Laustsen[6] remark "If a particular *Saccharomyces* species, or variety is wanted, the proper way is to obtain the original culture, if this is possible" (p 344) But then, if the species was isolated and described several years before, the culture obtained cannot be identical as that investigated by the discoverer It naturally follows that the very use of the name "species" itself would become questionable in the case of yeasts

When this is the case regarding the so-called species in yeasts, one can imagine the validity of the claim of Skovsted[4] that his type 20 which arose by mutation could be described as a new species Anyway, even if the above claim is accepted as valid, it does not entitle one to imagine that new species originate in higher animals and plants in such a simple fashion

(2) If there is such high mutability and progressive transformation going on in cultures, how is it that yeasts used in industry are highly stable? Winge[6] offers the following explanation While under industrial conditions Natural Selection weeds out those mutants having inferior growth rate, these persist in pure cultures where the limited amount of medium leads to early stoppage of growth with the resulting persistence of the mutants as resting cells. To those who are familiar with the problems concerning the so-called "bacterial dissociation"[7], the above explanation of Winge[6] is too simple to be valid Competition should be keener when the environment is the limiting factor

Investigators on yeasts have only dimly realized that very intricate populational problems determine the establishment of particular types of mutants It has to be definitely understood that in liquid media while the total number of cells may go on increasing, only a certain percentage are viable and these reach a maximum which is steady during further growth From the time the viable cells reach their maximum, the "populational pressure" selects those mutants having a higher growth rate or viability. It is not, therefore, a mere question of growth rate alone Viability comes into the picture Under certain conditions, even mutants having a slower growth rate but a higher viability can establish themselves[8] The nature of the environment determines both growth rate and viability.

Winge's[6] explanation takes into consideration only hypomorphic mutants. What about the hypermorphic ones having superior growth rate as well as viability? Winge and Roberts[9] consider that hypermorphs can occur (p. 269) If that is so, then, even under industrial conditions selection should proceed to a stage where further mutations in the positive direction under such specific conditions is not possible

(3) If the cultures are progressively changing their characteristics, is there any method by which they could be stabilized? To those interested in producing new strains for industry this is a vital question and for this vital question there is no answer in the published literature

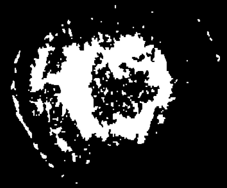
To us this problem has been one of major importance It is virtually impossible to carry out simultaneously the cytogenetical and biochemical investigations on the new strains New strains have first to be produced and their stability tested before any biochemical investigations are possible Very early during our investigations we discovered[10-14] that induction of tetraploidy was possible.

Stabilization by artificial induction of polyploidy thus became a possibility, and continuous observations on the giant colonies of the induced tetraploids[12,18] confirmed their stability This led to the next logical conclusion that when mutations at the loci determining the nature of sculpturing of the giant colony could be prevented from finding expression, similar mechanisms should operate in the case of those loci controlling biochemical characteristics also

Thus the gloomy picture that emerges after a critical evaluation of the previous literature ceases to have any reality and as would be shown in the discussion, our co-ordinated intensive work indicate that it may be possible to produce specific stable types

Isolation & Previous Investigations on the Strain

The new strain was obtained when the two-chromosome control was treated with acenaphthene for 90 days[2,15] It was isolated at the same time as the autotetraploid, BY 3, and the culture was kept growing in wort and wort agar A cytological examination immediately after isolation revealed two unequal chromosomes The cause for this inequality was assumed to be the result of a loss of a bit of one of the chromosomes and its poor growth was attributed to this deficiency The culture was kept in a very active condition and it began to show normal



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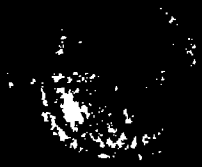

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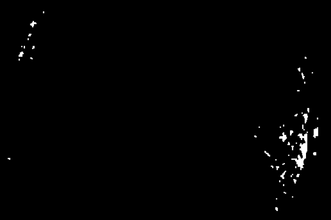


growth after the lapse of a few months The acenaphthene treatment was carried out in wort, the strain was purified by plating in wort agar, and it was grown in wort and wort agar The adaptation to normal growth should, therefore, be the result of a simple gene mutation A locus determining growth rate occurs in the control[3] and the mutation should have been to a relatively hypermorphic allele

Indirect evidence in support of the above possibility was obtained from the observations of Prema Bai[16] on the nutritional requirements of this strain In comparison with the control and the autotetraploid, this top yeast, BY 2, was relatively autotrophic This surprising result indicated that the real change is not one of deletion but a translocation In the control there is a locus governing the growth rate The chromosomal translocation may have resulted in an alteration of some of the gene sequences and the poor growth may be the consequence The appearance of a more efficient allele at the growth-rate locus is probably the observed adaptation for normal growth in wort and wort agar

Whether this type of mutation is induced only by acenaphthene or whether the different agencies inducing polyploidy produce also top yeasts was next investigated A tetraploid and a top yeast, BY 5, were isolated from a culture kept in an active condition in the ice room for 90 days[17] The similarity between the giant colonies of the tetraploids and top yeasts produced by such entirely different agencies was remarkable[12] Prema Bai (unpublished) discovered that their nutritional requirements were also identical

← FIG 1 — BY 2 12-DAY GROWTH, 2 2 CM 27TH SEPTEMBER 1946 (*After Subramaniam and Rangnathan*)

FIG 2 — BY 5 12-DAY GROWTH, 1 7 CM, 6TH NOVEMBER 1946 (*After Subramaniam and Ranganathan*)

FIG 3 — BY 2 18-DAY GROWTH 2 7 CM 28TH FEBRUARY 1947

FIG 4 — BY 5 18-DAY GROWTH, 2 4 CM, 28TH FEBRUARY 1947

FIG 5 — BY 2 (LONG MYCELIAL) 23 DAY GROWTH, 1 7 CM 10TH APRIL 1947

FIG 6 — BY 2 (SMALL MYCELIAL) 23 DAY GROWTH, 2 2 CM, 10TH APRIL 1947

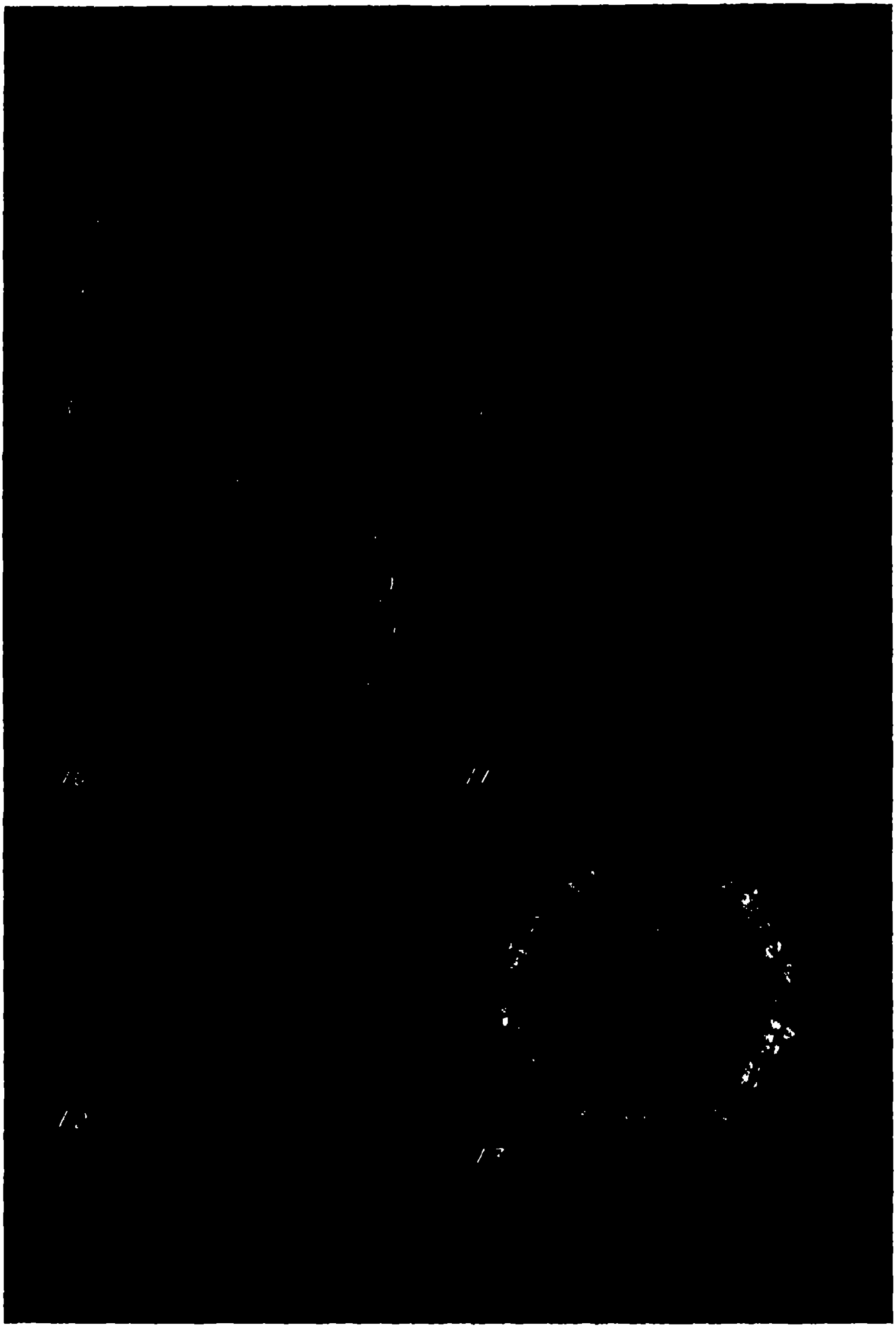
FIG 7 — BY 5 (LONG MYCELIAL) 34-DAY GROWTH, 3 2 CM, 21ST APRIL 1947

Stability tests were started before the commencement of the biochemical investigations and judgement was based on the changes occurring in the giant colonies The method for the preparation of giant colony media has already been given elsewhere[15] The colonies were grown at the room temperature

Observations

The top yeasts obtained after treatment with acenaphthene (BY 2) and culturing in the ice room (BY 5) produced giant colonies (FIGS 1 and 2) identical in appearance These were smooth, thin and glistening and had a circular furrow near the margin The area outside the furrow was rough These photographs were taken late in September and early in November 1946 In February 1947, the area outside the marginal furrow was wider (FIG 3) and its sculpturing more pronounced The strain, BY 5, on the other hand, developed into a colony indistinguishable (FIG 4) from that observed in November 1946 (FIG 2) All along, the cells in the cultures were polymorphic and an attempt was made to study whether there was any difference in the appearance of the colonies grown from the long and the short mycelial cells These types were repeatedly plated during March 1947 and giant colony inoculations were carried out Both types produced giant colonies remarkably similar in appearance (FIGS 5 and 6) The colony in Fig 5 shows two mutants as rosette-like knobs The long mycelial cells of BY 5 gave a colony (FIG 7) resembling that illustrated in Fig 4 It showed two sectors As expected, the short and long mycelial types in wort-agar cultures gave only cells widely ranging in size (*see* Text Figs 3 and 5, Subramaniam and Ranganathan[12]), leading to the conclusion that polymorphism is not due to specific genetic factors In May-June 1947, BY 2 and BY 5 colonies resembled in their sculpturing those illustrated in Figs 5 and 6 and hence experiments were carried out to test whether the two strains obtained by entirely differing agencies were comparable

The two strains were, therefore, cultured separately in wort and 24 hour cultures were mixed together, well shaken and used for giant colony inoculation The colony which developed (FIG 8) showed no sectors indicating that they were identical in genetic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constitution The colony of BY 2, which was grown at the end of September 1948, is illustrated in Fig 9. The sculptured rim was less broad and reminiscent of the condition in September 1946 It shows also a smooth sector The stability of the two strains was tested again after a lapse of 14 months in January 1949 During the interval, little attention, beyond regular sub-culturing once in 5 weeks, was bestowed on them The colony of BY 2 (FIG 10) is comparable with that obtained more than 2 years back The colony of BY 5, on the other hand, is highly sectored (FIG 11) but had the characteristic furrow as well as the sculptured rim

Actively growing cells of the top yeast, BY 2, were treated for about 5 months with acenaphthene during the latter part of 1948 and the resulting culture was composed entirely of cells having a comparable polymorphism as the original type The giant colonies of the purified treated culture were different in appearance It was dirty brown in colour, was uniformly smooth and had no marginal furrow or a sculptured rim (FIG 12). During the summer of 1949 it suddenly sporulated after only 4 weeks' growth on the agar slant and the culture could not be revived Further experiments to confirm that tetraploidy could be induced in top yeasts is under investigation

In the control two-chromosome strain, a particular genic combination (*rim/smooth*) mimics the sculpturing of the giant colonies of the top yeasts Such a colony was illustrated as Fig 1*f* by Subramaniam and Ranganathan[8] Periodically this unstable combination turns up in the control cultures and another example is illustrated in Fig 13

Discussion

From a continuous series of observations on reverse mutations in our control, it was suggested that multiple alleles occur at the locus determining the nature of sculpturing of the giant colonies[18,19] Prema Bai's[16] investigations indicated that the top yeasts are the result of a chromosomal translocation If we assume that as a consequence of this chromosomal translocation the genic sequences in the two unequal chromosomes of the top yeasts have been altered, the mutations at the loci governing the nature of sculpturing of the giant colonies should produce phenotypic expressions entirely different from that observed in the control That mutations to the different alleles are occurring at the locus would be evident from the waxing (FIGS 5 and 6) and waning (FIGS 1 and 2) of the size of the sculptured rim of the top yeasts during the different months of the year, when cultured at the room temperature As would be seen from Figs 1 and 4 in the initial publication by Subramaniam and Ranganathan[18], the control colony was *smooth* when the sculptured rim of the top yeasts was narrow In April-May, when the colony of the control was *rough* (Fig 3, Pl 1 , Subramaniam, Ranganathan and Krishna Murthy[19]), the top yeasts developed into colonies having well-sculptured broad rims (FIGS 5 and 6) This correlation suggests that mutations to the different alleles occur in the top yeasts also, but that the ascending grade of complexity in the giant colony sculpturing is absent in the top yeasts Fig 11 of the top yeast, BY 5, indicates that different allelic combinations occurring in the top yeast may also give rare types of sculpturing not usually observed in active cultures Just as in the different strains of the control, the changes in the giant colony characteristics in BY 2 and BY 5 are parallel but not synchronous

It is interesting to refer here to the resemblance of a particular genic combination in the control mimicking the type of sculpturing observed in the top yeasts This implies that the characteristic sculpturing observed in top yeasts is not something novel Goldschmidt's[20] investigations indicate that phenocopies may resemble those normally produced by genetic factors Not only the environment but the genotype also determines the mode of expression The altered genotype resulting from a chromosomal translocation conditions probably the expression of the different alleles in the top yeast.

The changes observed in the top yeasts are reversible as in the control[18] and progressive non-reversible changes have not been

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← FIG 8 — BY 2 + BY 5 14-DAY GROWTH, 2 5 CM , 15TH JULY 1947

FIG 9 — BY 2 16-DAY GROWTH, 2·6 CM , 30TH SEPTEMBER 1947

FIG 10 — BY 2 29-DAY GROWTH, 2 8 CM , 12TH JANUARY 1949

FIG 11 — BY 5 27-DAY GROWTH, 2 8 CM , 3RD JANUARY 1949

FIG 12 — BY 2 TREATED WITH ACENAPHTHENE . 27-DAY GROWTH, 3 5 CM , 11TH MARCH 1949

FIG 13 — BY 1, CONTROL 19-DAY GROWTH, 3·0 CM , 14TH SEPTEMBER 1948

observed in top yeasts during the past three years Since the genes at the locus determining the nature of sculpturing of the colonies show reversible mutations and when the environment determines which of the mutants should predominate during any particular season, we have to conclude that the genes governing biochemical characteristics should behave in an identical fashion

Winge[6] considers that mutations affecting physiological characteristics should also occur He, however, qualifies the above statement and suggests that these mutations may not affect the ability to produce species specific enzymes but modify the quantity of the enzymes produced The probable cause for the above state of affairs was indicated by Subramaniam[21] in an earlier contribution It appears as if a number of genes control the different fundamental steps of fermentation of any sugar and hence mutation of any one of them may affect adversely the fermentative ability of the strain The logical conclusion was that the genes responsible for the various basic steps of fermentation should possess very low mutation frequencies Are they heterochromatic? That it may be so was indicated by the fact that these genic combinations begin functioning only when duplicated above a particular basic stage of endopolyploidy It was also indicated[14] that this method of genic action is not something unique A further extension is possible The genes said to initiate the production of melibiozymase or galactozymase may in all probability, govern only the master reactions

Much of the confusion seen in the literature is primarily due to the inability of the investigators to classify the mutations into distinct categories It appears likely that polyploidy, chromosomal translocations and gene mutations have all been treated as though they belong to the same category The first two are non reversible while the last one ought to be reversible

Our observations indicate that non-reversible mutations resulting from chromosomal changes could be induced The problem of stability is, therefore, capable of an analysis Among chromosomal changes, translocations belong to a separate category Only once during the past five years have we observed the spontaneous occurrence of a top yeast in our control All the strains of top yeasts in our collection were isolated after long exposure of the control to chemical and physical agencies While in 1945 top yeasts could be obtained from the control by such agencies, similar production was not possible in 1947 when the experiments were repeated[18] Treatment with acenaphthene for about 45 days produced only a tetraploid Since the control does not normally give rise to top yeasts, it could be classified as stable On the other hand if a strain produces top yeasts with a high frequency one has to naturally assume that it is unstable The wide differences between the morphological and biochemical characteristics of the top yeasts, as compared with that of the control, indicates that it could even be described as a new species An origin of new species is thus possible and in a strictly comparable manner as presumed in the case of higher organisms Is it this type of mutation that Skovsted[4] observed in *Nadsonia*?

Tetraploid sectors occur periodically in our control two chromosome strain It was indicated previously that it may be possible to obtain tetraploid top yeasts The autotetraploid BY 3[11] exhibits identical nutritional requirements as the control[16] but it has a quicker growth[22] and fermentation rate[23] The polyploids are highly stable but there is a limit to the duplication of the chromosomal complement The high stability of the types used in industry is not due to chances for unlimited proliferation or a favourable environment but should be the result of polyploidy The conscious and unconscious selection that has gone on should have resulted in the selection of ideal polyploids

Induction of polyploidy is a possibility and hence the question of stability ceases automatically to be a nightmare to the practical breeder

Summary

1 Artificially produced top yeasts appear to be autotrophic and aerobic and excrete into the wash considerable amounts of riboflavin The possibility that these may be highly useful for compressed yeast manufacture necessitated a consideration of the problem of stability in yeasts

2 Investigators subscribe to the belief that yeasts are unstable The problem of stability has received only scant attention and no previous attempt has been made to

discover methods to induce stability Literal acceptance of the above view would not only invalidate the classification of yeasts into species and genera but would also leave unexplained why the strains used in industry are highly stable

3 Systematic observations of the changes in the sculpturing of the giant colonies of top yeasts extending over two years indicate only a waxing and waning of the size of the rough rim during the different seasons when cultured at the room temperature

4 The waxing and waning of the sculptured rim parallels the predominance of the rough and smooth types of colonies in the control which have already been interpreted as the result of mutations to different alleles at the locus determining the nature of sculpturing Since the top yeasts appear to be the result of a chromosomal translocation the genic sequences should have been altered and as a result the mutations at the loci governing the nature of sculpturing should produce phenotypic expressions entirely different from that observed in the control Tetraploids are highly stable and industrial types should be polyploids

5 Induction of polyploidy is a possibility

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Some Factors Affecting the Bactericidal Property of Lemon-Grass Oil Emulsions

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Factors effecting the germicidal efficiency of commercial lemon grass oil samples have been examined with a view to standardizing conditions for the preparation of disinfectants It has been demonstrated that the bactericidal efficiency of lemon grass oil is directly proportional to the citral content in it Homogeneous dispersion of the oil and stability of the emulsion are two important factors on which its bactericidal action depends Of the emulsifying agents tried triethanolamine or potassium oleate and rosin soap have been found to be the best Particle size and germicidal potency of several emulsions have been studied No direct relationship exists between the viscosity of lemon grass oil emulsions and its bactericidal action The maintenance of the *p*H of the emulsified disinfectants within a specific range is important from the point of view of the stability of emulsions Use of emulsifying agents and the solvents in excess in the preparation of disinfectants is shown to lower the bactericidal action and the stability of the emulsions on dilution

VERY little work has been done on the factors influencing the disinfecting potency of emulsified disinfectants Romaine[1] indicated in a general way the important factors upon which the phenol coefficient of a pine oil disinfectant depends viz (i) the amount of bacteria killing constituents in pine oil (ii) the emulsifiable properties of pine oil and (iii) the emulsifying properties of the emulsifiers used Daniels and Lyons[2] studied the influence of physical properties (viz adsorption solubility particle size hydrogen ion concentration viscosity and surface tension) of certain phenyl substituted acid solutions on their bactericidal power Martin Frobisher[3] studied the influence of surface tension depressants on the germicidal activity of certain phenols De and Subrahmanyan[4] studied the effect of the concentration of soap used on the bactericidal action of essential oil emulsions

In a previous communication[5] it has been reported that of a number of Indian essential oils examined lemon grass oil possesses the highest bactericidal action although its efficiency is much reduced in the presence of organic matter and the activity against Gram positive organisms is low and practically nil against acid fast organisms In the present study the factors affecting the germicidal efficiency of lemon grass oil have been critically examined with a view to standardizing the conditions necessary for the preparation of a suitable disinfectant out of it The influence of the following factors (a) concentration of the chief constituent in the oil (b) emulsifiable property of the oil (c) efficiency of different emulsifying agents (d) concentration of the emulsifying agent (e) stability of emulsion (f) use of alcohol in the preparation of emulsion via solution (g) *p*H of emulsion (h) particle size and (i) viscosity on the germicidal efficiency of lemon grass oil have been investigated

As the present investigation requires the preparation of only oil in water type emulsions our attention has been confined to the selection of only hydrophilic emulsifiers For the preparation of oil in water emulsions the emulsifying properties of different soaps[6-8] sulphonated oils[9] water soluble gums[10] gelatin[11] etc are well known A few of the more efficient and easily available emulsifying agents have been used in the present study

With regard to each class of emulsifying agents there is a specific range of *p*H at which only the emulsion is stable It is a well established fact that emulsions prepared with soaps are stable at alkaline *p*H only According to Krantz and Gordon[10] gum acacia emulsions are stable over the *p*H range 2 10 gum tragacanth emulsions over the *p*H range 1 9 2 3 Emulsions prepared with sulphonated vegetable oils are most stable at a slightly acidic *p*H[12] Investigations by Friedman and Evans[11] showed that gelatin emulsions are stable at the *p*H range 3 6 In the present study the *p*H of lemon grass oil emulsions prepared with different emulsifying agents have been so adjusted as to make them stable

Experimental

Commercial samples of lemon grass oil obtained from different sources were analysed for citral content by the hydroxylamine hydrochloride method[13] As mentioned in the previous communication[8] the different samples of oils were emulsified under identical conditions using 1 per cent of the oil to be tested 1 per cent potassium oleate as the emulsifying agent and 0 5 per cent potassium carbonate as the emulsion stabilizer and examined for the Rideal Walker coefficient using *B typhosus* as the test organism The results are given in Table I

TABLE I — CITRAL CONTENTS & BACTERICIDAL POTENCIES OF COMMERCIAL SAMPLES OF LEMON GRASS OIL

Sample No	Original oil		Citral content equalized to 80±0 5 %	
	Citral %	R W coeff	R W coeff	Particle size μ
1	41 44	6 5	13 5	
2	71 85	9	14	
3	78 28	12 5	15	6 41
4	62 40	6	12	
5	48 21	3	11	7 84
6	52 47	8 5	15	6 33
7	72 27	9	14	
8	55 15	5 5	10	7 99
9	68 79	9	15	
10	82 04	14		
11	64 09	6	15	
12	45 84	4	11 5	
13	74 20	8	10 5	7 68
14	80 12	9		8 09

As the emulsions were prepared under identical conditions the different R W coefficients obtained for different samples of oils may be due to varying amounts of citral contents as also to the varying emulsifiable properties of the oils

In order to eliminate the influence of the varying amounts of citral present in the oils the citral contents of all the samples were brought to the same level (80 ± 0 5 per cent) by adding the required amounts of citral isolated[14] from a sample of freshly re steam distilled lemon grass oil by mechanically shaking the oil with a solution of a mixture of sodium sulphite and sodium bicarbonate and liberating citral from the solution of the additive compound formed by alkali and ether in the usual way and finally vacuum distilling the compound at 10 mm pressure These oils of the same level of citral content were emulsified under identical conditions and examined for R W coefficient as mentioned before Those samples which showed marked variation in R W coefficients even after equalization of citral contents were selected and the emulsions examined in the ultra microscope for particle size by the method as described by Freundlich[15] The results obtained demonstrate that the emulsifiable property of the oils is partly responsible for differences in R W coefficients The results are shown in Table I

To demonstrate the influence of citral content of the oil on its bactericidal action the following experiment was conducted

From freshly re steam-distilled lemon grass oil containing 87 43 per cent citral the pure compound was isolated[14] by the sodium sulphite process The citral isolated had b p 107° 109 C at 10 mm pressure and ref index 1 4873 at 20°C To the aldehyde free oil different proportions of pure citral were added so as to obtain several samples of oil of identical emulsifiable properties but of different citral contents The emulsions were prepared under identical conditions and examined for their bactericidal action by the Rideal Walker method The results are given in Table II

The results showed that the citral content of lemon grass oil is one of the main factors on which its germicidal power depends

Next to demonstrate the influence of different emulsifying agents on the germicidal action of lemon grass oil a sample of freshly re steam distilled oil of high citral content (84 20 per cent) was emulsified using 1 per cent oil and 1 per cent of different emulsifying agents Each of the soaps or gums used was first soaked in a small amount of water

TABLE II — INFLUENCE OF CITRAL ON THE BACTERICIDAL ACTION OF LEMON-GRASS OIL

SAMPLE OF OIL	CITRAL, %	R W COEFF
Fresh re-steam-distilled oil	87 43	17 5
Aldehyde free oil		<1
Sample A	20	3
Sample B	40	7
Sample C	60	10
Sample D	80	13 5
Pure citral		20

the oil added and the mixture triturated thoroughly in a mortar till the oil was properly incorporated and a creamy paste resulted On dilution to the required volume, the paste formed a milky emulsion which was finally homogenized thrice in a small mechanical homogenizer In the case of Turkey red oil, it was mixed with lemon-grass oil by trituration in a mortar, diluted to the required volume and mechanically homogenized In the case of gelatin, it was first dissolved in hot water, cooled, the oil incorporated and the mixture mechanically homogenized, but the emulsion was not stable even for the duration of the test period

The fatty oil soaps used were prepared from the corresponding oil and caustic potash solution by the " boiling process " Triethanolamine oleate or stearate was prepared by dissolving the equivalent amount of triethanolamine and oleic or stearic acid in absolute alcohol, refluxing the mixture for about 3 hr and then distilling off the alcohol Potassium oleate or stearate was prepared by the neutralization of an alcoholic solution of oleic or stearic acid by alcoholic potash in a similar way Rosin soap was prepared by refluxing for about 12 hr. a mixture of powdered rosin and caustic potash dissolved in alcohol In the preparation of these soaps, alkali was used in a slight excess of the theoretical amount The soaps prepared were finally dried in a desiccator

The *p*H of the individual emulsions was so adjusted as to make them quite stable Saturated solutions of tartaric acid and sodium carbonate were used for adjusting the *p*H on the acid and alkaline side respectively All determinations or adjustments of *p*H were made in the Leeds and Northrup glass-electrode potentiometer against standard M/20 buffer solution of potassium hydrogen phthalate

Each emulsion was examined with the least possible delay for R-W coefficient, particle size, viscosity and stability Viscosity was determined by the standard method[16] in Ostwald's viscometer using a glass thermostat at 25°C ±0 1 The time of flow was recorded ten times for each sample and averaged and the results were expressed in centipoises In order to compare the stability of the emulsions prepared, they were kept in tall glass cylinders of the same size, exposed to atmospheric conditions and the period after which there was any separation of oil was noted The results are given in Table III

TABLE III — INFLUENCE OF DIFFERENT EMULSIFYING AGENTS ON THE BACTERICIDAL ACTION OF LEMON-GRASS OIL (CITRAL CONTENT, 84·20%)

EMULSIFYING AGENT USED	*p*H	R W COEFF	PARTICLE SIZE, μ	VISCOSITY centipoises	APPROXIMATE DURATION OF STABILITY OF EMULSION, days
Potassium stearate	8 08	9 5	9 05	1 420	2
Potassium oleate	8 13	16 5	6 37	1 153	60
Groundnut oil soap	8 16	11 0	8 33	1 199	10
Coconut oil soap	8 19	10 0	9 19	1 318	5
Castor oil soap	8 05	10 5	8 63	1 190	10
Rosin soap	8 02	16 5	6 95	3 205	60
Triethanolamine stearate	7 40	9 0	9 12	3 609	3
Triethanolamine oleate	7 43	16 5	6 19	3 181	60
Turkey red oil (sulphonated castor oil)	6 51	9 0	9 91	2 201	10
Gum acacia	5 28	13 0	8 13	2 324	45
Gum tragacanth	2 18	6 0	12 36	29 32	30
Gelatin	4 95				very unstable

The results clearly show the comparative efficiency of different emulsifying agents used

De and Subrahmanyan[4] found 1 per cent soap to be the optimum concentration for the emulsification of 1 per cent essential oil To determine whether the concentration of water soluble gum acacia had any influence on the germicidal action of lemon grass oil a number of emulsions containing 1 per cent oil but different amounts of gum were prepared under identical conditions and their bactericidal power was determined The results are shown in Table IV

TABLE IV — INFLUENCE OF THE CONCENTRATION OF GUM ACACIA ON THE BACTERICIDAL ACTION OF LEMON GRASS OIL (CITRAL CONTENT 84 20%)

EMULSIFYING AGENT USED & CONCENTRATION per cent		R W COEFF	APPROXIMATE DURATION OF STABILITY OF EMULSION days
Gum acacia	(1)	13	45
	(1 5)	13	45
	(2)	11	60
	(2 5)	9 5	60
	(3)	8	90
	(4)	3 5	90

With a concentration lower than 1 per cent gum the stability of emulsion was not satisfactory It is also obvious that increasing amounts of gum lower the germicidal activity appreciably

To study whether the variation of *p*H within the specific range at which the emulsion would remain stable for a long period could exert any influence on the germicidal action of lemon grass oil an emulsion which would remain stable over a long range of *p*H was selected It was observed that the emulsion prepared with gum acacia could remain stable for a long period at different *p*H values (range 3 9) The *p*H of a portion of the emulsion prepared with 1 per cent oil and 1 per cent gum was brought to the alkaline side that of a second portion to the neutral and that of the rest on the acid side The emulsions of different *p*H values were tested both fresh and after 15 days storage in glass stoppered bottles for the R-W coefficient and change of odour The results are given in Table V

TABLE V — INFLUENCE OF *p*H ON THE GERMICIDAL ACTION OF LEMON GRASS OIL (CITRAL CONTENT 84 20%) EMULSION

EMULSIONS	*p*H	R W COEFFICIENT		CHANGE IN EMULSION AFTER 15 DAYS STORAGE
		Fresh	15 days old	
Sample I	3 47	13	<1	No separation original odour changed
Sample II	7 02	13	9	No separation original odour retained
Sample III	9 01	13	4	No separation original odour changed entirely different from that developed in Sample I

The results showed that *p*H had apparently no influence on the bactericidal action of freshly prepared emulsion provided the emulsion remained stable at the altered *p*H

Instead of preparing the emulsion directly preparation of a solution of lemon grass oil and emulsifier which on dilution with water would form a milky emulsion is more advantageous for practical purposes Hence it was thought desirable to study the effect of the solvent used on the bactericidal action of the disinfectant preparation Absolute alcohol being a common solvent for the oil as well as for the comparatively more efficient emulsifying agents like triethanolamine or potassium oleate and rosin soap was used for these experiments The solutions were prepared with 1 gm lemon grass oil 1 gm potassium oleate and varying proportions of absolute alcohol and subsequently diluted to 100 c c with the required volume of water to form emulsions The emulsions formed were tested for R W coefficient and stability as before The results are shown in Table VI

TABLE VI — EFFECT OF ALCOHOL ON THE BACTERICIDAL EFFICIENCY OF LEMON GRASS OIL (CITRAL CONTENT 84 20%) SOLUTIONS WHICH ON DILUTION FORM EMULSIONS

PREPARATION OF EMULSION		R W COEFF	APPROXIMATE DURATION OF STABILITY OF EMULSION days
(1) O l oleate and alcohol made up to	50 c c	3	1
(2)	40	4	2
(3)	30	6	7
(4)	20	9	15
(5)	10	12	25
and emulsion formed			

The results showed that it is important to reduce the proportion of the solvent to a minimum to ensure maximum bactericidal potency of the preparation

Discussion

Commercial samples of lemon-grass oil were found to have R-W coefficients ranging from 3 to 14 and citral contents varying from 41 to 82 per cent Table II shows that lemon-grass oil owes its disinfecting power principally to its citral content Hence, the estimation of citral in the original oil is an index of its efficiency for use as a disinfectant

The other factors on which bactericidal action of lemon-grass oil emulsion depends are its maximum and uniform dispersion in water and stability of emulsion The results recorded in Tables I and III show that the efficiency of emulsification and the stability of emulsion formed are dependent on the emulsifiability of the oil and the efficiency of the emulsifier used Table I shows that a few samples of oil (sample Nos 4, 5, 8, 12, 13, 14) could not be emulsified to the same extent as the other samples, although the emulsions were prepared under identical conditions and the same emulsifying agent was used The emulsions prepared with the former gave comparatively lower R-W coefficient As the citral content of all the samples was equalized and as the emulsions were prepared under identical conditions, the lower R-W coefficient, as obtained with these samples, is due to their low emulsifiable property as is indicated from the comparatively larger particle size of the emulsions prepared out of them These samples of oils of lower emulsifiable property had a dark colour in comparison with the light colour of the other samples and contained resinous impurities, showing that the distillation in such cases was carried too far during manufacture

As shown in Table III, with the use of different emulsifying agents in the preparation of emulsions, different R-W coefficients were obtained, although the same oil was used in all the cases It is obvious, therefore, that the bactericidal action of an emulsified disinfectant is dependent to a great extent upon the efficiency of the emulsifying agent used Of the several emulsifying agents examined, triethanolamine oleate, potassium oleate and rosin soap were found to be more efficient than others The emulsifying capacity of stearate soap was inferior to that of the oleate soap Gum-acacia was better than tragacanth as an emulsifying agent for lemon-grass oil

The difference in the degree of emulsification with different emulsifying agents is also obvious from the varying particle size, viscosity and stability of the emulsions, although the difference is not very marked in some cases As is to be expected, with finer particle size of the emulsions, the bactericidal potency is found to be higher The bactericidal action of an essential oil emulsion may be caused by its covering power on the bacteria which are killed by adsorption of the essential oil Hence, the more finely dispersed is the oil, the more is its covering power on the bacteria and hence the higher its bactericidal efficiency

The viscosity of lemon-grass oil emulsions prepared with different emulsifiers, however, appears to have no direct influence on their bactericidal property Although the viscosity of rosin soap or triethanolamine oleate emulsion is comparatively higher than that of the emulsion prepared with potassium oleate, their R-W coefficients are of the same order Again, the viscosity of tragacanth emulsion is appreciably higher than that of the acacia emulsion, but the R-W coefficient of the former is much lower than that of the latter Daniels and Lyons[8] also could not find any relationship between the viscosity or *p*H of certain phenyl-substituted acid solutions and their bactericidal action

The results given in Table V indicate that there is no variation of germicidal potency in the freshly prepared emulsions of neutral, acidic or alkaline *p*H if the emulsion remained stable at different *p*H values , the variation in *p*H, however, exerts an adverse effect on the conservation of the original potency in stored emulsions as also on the retention of the perfume The emulsion having neutral *p*H maintained the original potency and perfume on storage, whereas in emulsions of highly acidic or alkaline *p*H the original disinfecting potency and perfume rapidly deteriorated Again, the characteristic smell developed in the stored emulsion of acidic *p*H was entirely different from that developed in the emulsion of alkaline *p*H

The results given in Table IV reveal that 1 0 to 1·5 per cent gum is the optimum concentration for the emulsification of 1 per cent lemon-grass oil as also for conserving its highest bactericidal action. Higher concentration of gum lowers the R-W coefficient markedly, although the emulsions prepared with higher concentrations of gum were stable over longer periods. This reduction in bactericidal potency may be due to adsorption of excess gum on the surfaces of bacteria with the formation of a protective film. Martin Frobisher[3], and De and Subrahmanyan[4] also observed that an excess of soap inhibited the bactericidal action of certain phenols and emulsified disinfectants and stated that excess of soap coated the bacterial surface with a film which would protect the cells from contact with the disinfectant.

The results given in Table VI indicate that excess of solvent used in the preparation of lemon-grass oil solutions markedly reduces the bactericidal efficiency and stability of the final emulsion. Even with the use of the least possible solvent, the R-W coefficient (12·0) and duration (25 days) of stability of the emulsion formed are much lower than the R-W coefficient (16·5) and the duration (2 months) of stability of the emulsion prepared directly without the use of solvent, although the same sample of oil and the same emulsifying agent were used in either case (cf. TABLES III and VI). Chick and Martin[17] compared the power of a germicide emulsified or dissolved and noted the superiority of the emulsified form and stated that emulsified disinfectants possess superior efficiency, because owing to the higher adsorption, the bacteria become surrounded rapidly by emulsified disinfectants in much greater concentration.

The results of the present investigation may find practical application in the preparation of an emulsified disinfectant out of lemon-grass oil.

Summary

(1) The citral contents and R-W coefficients of a number of commercial samples of lemon-grass oil have been determined.

(2) The influence of several important factors on the germicidal efficiency of lemon-grass oil emulsions has been studied. It has been demonstrated that all other factors being identical, the bactericidal efficiency of lemon-grass oil is directly proportional to the citral content.

(3) The highest and most homogeneous dispersion of the oil in water and the stability of the emulsion are two important factors on which its bactericidal action depends. These factors again are naturally dependent on the emulsifiable property of the oil and the efficiency of the emulsifying agent used in the preparation of the emulsion.

(4) The comparative efficiency of different emulsifying agents has been studied with reference to bactericidal action, particle size, viscosity and stability of lemon-grass oil emulsions. Triethanolamine or potassium oleate and rosin soap have been found to be more efficient than the other emulsifiers examined.

(5) Particle size and germicidal potency of the emulsions prepared with different emulsifiers have been correlated. No direct relationship, however, has been found between the viscosity of the emulsion and the bactericidal action.

(6) The *p*H of emulsified disinfectants is important from the point of view of the stability of emulsion. The variation of *p*H within the specific range at which the emulsion would remain stable appears to have no influence on the bactericidal action of freshly prepared emulsions but adversely affects the bactericidal property of the emulsions on storage.

(7) Use of an emulsifying agent in concentrations higher than the optimum has been found to lower the bactericidal action of lemon-grass oil emulsions.

(8) The least possible amount of solvent should be used in the preparation of disinfectant solutions which, on dilution, form emulsions. Excess of solvent used in the preparation of disinfectant solution of lemon-grass oil has been observed to lower their bactericidal action as also the stability of the emulsions formed on dilution.

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Radioactivity of Travancore Monazite Sands, Rocks & Mineral Waters

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The radioactivity of several typical samples of rocks and mineral waters of south Travancore has been estimated using an emanation electroscope As compared with similar sources in other places, the activity of spring and well waters including those collected from the monazite beds is rather low The average radium content of the igneous rocks is $2{\cdot}16 \times 10^{-12}$ gm./gm. which is in close agreement with that obtained for the basalts of the Deccan. It is nearly three times the value obtained for the granites of the Kolar Gold-fields The radium content of Travancore monazite sand is $12\ 32 \times 10^{-10}$ gm./gm. This agrees with the result obtained for the same mineral collected from Norway, Brazil, etc. It also shows that the average uranium content of Travancore monazite is 0 36 per cent.

STUDIES on the distribution of radioactive elements within the accessible regions of the earth's crust as also in the atmosphere are assuming importance They provide information on the origin of the earth's internal heat and on ionization phenomena in the atmosphere They are also of help in prospecting for radioactive minerals.

Investigations on radioactive minerals in India have been but few. The monazite sands of Travancore have received considerable attention More recently, the radium contents of rocks of the Kolar Gold-field Mines[1], and the Archean rocks of Mysore[2] have been examined, and the emanations of the Tuwa hot springs in Bombay have been studied by Sierp and Steichen[3]

A study of the radon contents of spring and well waters and of the radium contents of granites and monazite sands from south Travancore has been recently undertaken under the auspices of the Travancore University The results obtained are presented in this paper.

Experimental

Electroscope — An emanation electroscope has been designed and constructed (FIG 1) for this investigation The thick lead-walled instrument is divided into the ionization chamber A and the electroscope chamber B The former has 2 nozzles for evacuation and suction of the active gases while the latter is provided with the charging key K and thick glass windows W for observation The gold-leaf system consists of the central electrode P ending in a circular disc D within the ionization chamber, whose other extremity is in the electroscope chamber carrying the pillar Q to which is attached the gold leaf G The insulator S for the gold-leaf system is a sulphur plug held within a vulcanite ring with a guard ring in between The charging key connected to H T supply when pressed touches Q and thus charges the gold-leaf system

The required voltage (*c* 300 volts), as measured by an electro-static voltmeter, was obtained from a megger, thus avoiding the need for keeping a H T dry cell battery The lack of a steady H T supply, however, prevented the proper use of the guard ring Still the natural leakage of the instrument was so low that it could keep a charge for nearly 48 hr The rate of collapse of the gold leaf, ending in a fine quartz fibre and illuminated from behind, was observed by a microscope with divided eye piece The ionization chamber was evacuated using a *Cenco Hyvac* pump, into which space the active gases collected from the de-emanation equipment was admitted every time

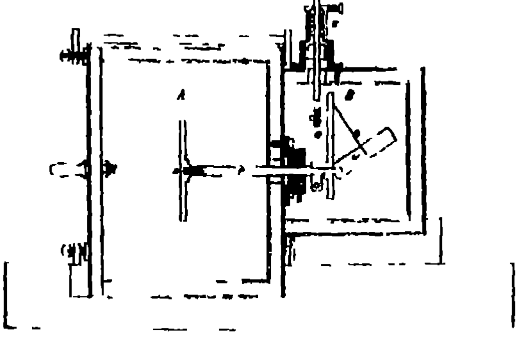

FIG. 1

De-emanation · (a) Mineral Waters — The water specimens collected from different sources were taken to the laboratory in corked bottles as quickly as possible to avoid too much decay of radon, the required correction for the interval being applied in every case A known volume of the liquid was boiled vigorously for half an hour and the escaping gases were collected through a Leibig's condenser The gases thus collected were allowed to stand for the decay of any thoron present and then sucked into the evacuated ionization chamber through drying tubes finishing with a current of fresh air from outside through the system until the pressure is normal

(b) Rocks — 25 gm of each of the samples were finely powdered in an agate mortar and fused with excess of sodium carbonate in a platinum crucible The fused mass was dissolved in a convenient volume of distilled water The cloudy solution was filtered and the alkaline filtrate kept aside as solution No 1 The residue was digested with strong hydrochloric acid and diluted to form solution No 2 The alkaline and acidic solutions thus obtained were allowed to stand for a few days for the radon to collect, after which they were subjected to the same treatment as was described for mineral waters Knowing the total quantity of radon collected during a known interval, the radium content of each of the samples was calculated

(c) Monazite Sand — This mineral could not be decomposed by alkaline fusion Borax fusion adopted by Strutt[4] was, therefore, applied 2 5 gm of the finely powdered mineral were fused with 15 gm. of borax in a platinum crucible for an hour The fused mass on cooling gave a clear, light-yellow, glass-like substance which was powdered and digested with dilute hydrochloric acid to give a nearly clear solution The solution was treated as before

Calibration of the Electroscope — A small quantity of a laboratory sample of radium bromide was taken and compared with a 1 mg radium needle obtained from the Government Hospital, Trivandrum, using the emanation electroscope for γ-ray comparison It was then dissolved in water acidulated with hydrochloric acid and containing a few grams of barium chloride in solution to minimize chances of precipitation of the active substance A standard solution of known strength was thus obtained with which the electroscope was calibrated A leakage of 1 div /min corresponds to $1{\cdot}19 \times 10^{-10}$ gm of radium in solution containing the equilibrium quantity of radon

Almost all the samples included in this study were tested for dissolved radium and the results every time were in the negative (TABLES I, II and III)

TABLE I — MINERAL WATERS

SAMPLE	EMANATION CONTENT (Curies per litre)
A Well waters	
Sample No. 1	$2\ 71 \times 10^{-10}$
,, No. 2	3 80
,, No. 3	2 92
, No. 4	1 43
,, No 5	1 49
No. 6	0 18
No. 7	0 10
, No. 8	2 67
B Spring waters	
Trivandrum No. 1	$7\ 47 \times 10^{-10}$
,, No 2	2 68
Warkala No. 1	0 07
,, No. 2	0 79
,, No. 3	0 98
,, No. 4	3 85
, No. 5	0 26
,, No. 6	1 47
,, No 7	9 36

C Waters collected from the sea, the monazite beds of Manavalakurichy and from within the railway tunnel at Aryancavu in the Western Ghats showed no detectable trace of radon.

TABLE II — ROCKS

SAMPLE	RADIUM CONTENT (gm./gm.)
Sample No. 1	$2\ 60 \times 10^{-12}$
, No. 2	2 28
,, No. 3	1 60

TABLE III — MONAZITE SAND

SAMPLE	RADIUM CONTENT (gm./gm.)
Chavara monazite	$12\ 78 \times 10^{-10}$
Manavalakurichy monazite	11 85

Discussion

Mineral Waters — The average value obtained for the emanation content of the mineral and well waters of south Travancore places them very low in the order of activity of similar sources throughout the world For example, the average value obtained by Seirp and Steichen for the well waters of Tuwa village seems to be about 5 times the highest value for well water obtained here while that of the hot springs of Tuwa is nearly a 100 times that of the strongest among the springs It is, however, interesting to note that the traditional preference among the residents of Trivandrum and Warkala is in favour of springs having a larger emanation content Curie and Laborde[5] have come to the same conclusion regarding the physiological effects and radioactive contents of the thermal springs of Austria

The low activity of waters collected from the dripping waters within the Aryancavu railway tunnel through the Western Ghats shows that the radium content of the hard rocky formations above is low

The poor radon content of water collected from sluices over the monazite beds is surprising, especially when compared with the high activity reported for water found in the pitch blende-occurring regions of St Joachimsthal of Bohemia The only possible explanation seems to be the poor emanating power of the radium present in the mineral The following experiment confirmed this view About 200 gm of monazite sand was allowed to remain in contact with about ½ litre of distilled water for 2 weeks The water, on examination, showed the presence of no detectable trace of radon As calculated from the radium content of monazite, the emanating power of monazite sand remaining in contact with water under normal conditions is less than 0 05 per cent of the total emanation content In the case of uranium mineral, Boltwood[6] has shown that even brief contact with the mineral can impart to the water remarkable radioactive properties due to dissolved radon Markal[7] made quantitative studies of the emanating power of residues of uranium ore from St Joachimsthal and found that under moist conditions as much as 3 4 per cent of the theoretical value of the total emanation content was liberated by the material The present value is less than a hundredth of that obtained by Markal and probably accounts for the low emanation content of the water

Rocks — The average radium content of the three types of igneous rocks is 2.16×10^{-12} gm /gm which is in close agreement with the average value of 2.2×10^{-12} gm /gm obtained by Joly[8] in 1911 for the basalts of Deccan But the mean value obtained later in 1924 by Poole and Joly[9] for the plateau basalts of Deccan and by Watson (loc cit) for the granite of the Kolar Gold fields was only 0.8×10^{-12} gm /gm which is decidedly less than the average radium content of rocks of south Travancore included in this study

The data collected in the course of this work are evidently inadequate to form any general conclusion regarding the radium content of Travancore rocks A representative collection of typical samples is expected to become available shortly from the Geological Department of this University enabling more extensive investigations to be made

Monazite Sand The average radium content of Travancore monazite is 12.32×10^{-10} gm /gm Travancore monazite thus appears to be about 8 times richer in radium content than Brazilian monazite which was shown by Baltuch and Wissenberger[10] to contain 1.54×10^{-10} gm /gm radium The result is in agreement with the value of Strutt for Swedish Brazilian and Norwegian monazites According to the present results the uranium content of Travancore monazite is about 0.36 per cent which is of the same order as that obtained for monazite sand of north Carolina Norway Brazil and Connecticut[11] This value is however only about a tenth of that reported to be present in exceptional specimens of vein monazite found in Travancore[12] The proportion by weight of radium to meso thorium prepared from Travancore monazite is about 98 per cent while about 16 per cent of its γ ray activity is due to the radium content Compared with the commercial preparations of meso thorium from Brazilian monazite[13], these values are appreciably lower

Acknowledgement

The author is indebted to the University of Travancore for facilities to undertake the work and to Professor V Sivaramakrishna Iyer under whose supervision the studies were made He acknowledges with gratitude the guidance and help rendered by Dr K L Moudgill who was keenly interested in the work

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A Rapid Method for the Analysis of Natural Graphite

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A rapid and convenient method for the analysis of graphite based on the procedure adopted for the proximate analysis of coal is described. No special equipment is needed in carrying out the analysis and the values obtained are about 1 per cent lower than those obtained by combustion in oxygen.

ALTHOUGH natural graphite is extensively employed in industry, no rapid and convenient method of analysis appears to have been developed The dearth of literature on this subject has been recently pointed out by Karunakaran and Narasingha Rao[1] Some of the known methods of analysis of graphite are (1) reduction of lead oxide, (2) wet combustion, (3) combustion in oxygen, and (4) fusion with caustic potash

Reduction of Lead Oxide — In this method[2], a weighed quantity (about 0 5 gm) of graphite is intimately mixed with about 30 gm of litharge and heated in a fire-clay crucible till the contents melt On cooling, the bead of lead formed by reduction of litharge by carbon is collected, cleaned and weighed The method is fairly accurate and rapid, but is not entirely satisfactory Because of high viscosity of molten litharge, lead globules are sometimes found disseminated in the solidified matrix and low results are obtained The crucible required should be dense and should be capable of resisting corrosion Fire-clay crucibles made in India are generally porous and unsuitable for these determinations Further, a crucible can be used but once as it gets badly corroded.

Wet Combustion — This method[3] consists in oxidizing graphite by a mixture of sulphuric and chromic acids and absorbing the carbon dioxide evolved The values for carbon observed by this method are usually high as the sulphur dioxide evolved during the experiment is also absorbed in the absorption system.

Combustion in Oxygen — Combustion of a weighed quantity of graphite in a current of oxygen and determination of the weight of carbon dioxide produced is the usual method followed at present[4,5] Combustion tubes of silica are required

Fusion with Caustic Potash — This method[6] consists in fusing graphite with solid caustic potash in a silver crucible when the impurities dissolve The fused mass is extracted with water, and the residue consisting of graphite and oxide of iron dissolved in an acid The graphite left over is weighed The values obtained are always low

An attempt has been made in our laboratories to determine the relative merits of the methods and to devise a simple and rapid procedure for the estimation of carbon in graphite

Experimental

Reduction of Lead Oxide — A weighed quantity (about 0 5 gm) of finely powdered and dried graphite was mixed with 30 gm of litharge and 10 gm of sodium carbonate and fused in a Battersia fire-clay crucible No C in a muffle furnace at about 1000°C When effervescence ceased, the crucible was taken out and the contents poured into a cast-iron mould The lead bead was cleaned and weighed

Wet Combustion — The apparatus consisted of an all-glass distillation flask (250 c c) fitted with a dropping funnel, the stem of which nearly reached the botton of the flask The dropping funnel was connected to a drying tube The flask was connected in series to an absorption bottle containing a strong solution of potassium permanganate saturated with carbon dioxide, a U-tube containing fused calcium chloride, a short silica tube containing coarse copper oxide and heated to 500°C., a weighed potash bulb, and finally, an aspirator through a guard tube

0·2 gm. of graphite was oxidized with a mixture of sulphuric and chromic acids (125 c c) in the distillation flask in a current of air and the weight of carbon dioxide determined and the carbon content was calculated in the usual way

Combustion in Oxygen — This was carried out according to Himus[7], with slight modification Copper oxide packing was only 4" long, because graphite contains very little volatile matter The carbon dioxide was absorbed in *carbosorb*

Proposed Method — This is based on the procedure adopted for the proximate analysis of coal 1·0 gm of graphite was heated in a procelain or silica crucible with its lid on for 7 min over a No 4 Mecker burner at about 800°C for the determination of volatile matter The graphite was then burnt off in a muffle furnace and the ash content determined The carbon content was calculated by deducting the sum of volatile matter and ash The experimental results are shown in Table I

TABLE I

SOURCE OF GRAPHITE	ASH % (a)	VOLATILE MATTER % (b)	GRAPHITE CARBON % 100 − (a + b)
Ceylon	3 62	1 40	94 98
Mysore	32 93	2 52	64 55
Mexico	12 508	1 84	85 66
Korea	18 38	1 85	79 77
Madagascar	12 49	2 24	85 27

The results obtained by the different methods outlined above are shown in Table II

TABLE II

SOURCE OF GRAPHITE	LEAD OXIDE METHOD %	WET COMBUSTION %	COMBUSTION IN OXYGEN %	PROPOSED METHOD %
Ceylon	95 21	93 05*	96 10	94 98
Mysore	63 69	66 11	66 23	64 55
Mexico	87 01	86 42	86 93	85 66
Korea	80 41	80 70	80 89	79 77
Madagascar	86 95		87 60	85 27

* Incomplete.

It will be seen from the above that the values obtained by the proposed method are about 1 per cent lower than those obtained by combustion in oxygen It is rapid and requires no special equipment

The author's thanks are due to Principal R. P Sinha and Prof S K Bose for their interest, and to Dr H N Das Gupta for helpful suggestions and criticism

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Letters to the Editor

RIBONUCLEASE ACTIVITY OF SOME INDIAN PULSES & OILSEEDS

IN THE COURSE OF OUR CYTOCHEMICAL studies of yeast cells[1] and fungal mycelia, it was found essential to employ specific enzymes for the location and characterization of cellular bodies One of the enzymes which is attaining great importance in such studies is ribonuclease which has been prepared by Kunitz in a crystalline form from beef pancreas[2] This enzyme has been used recently for distinguishing the ribonucleo protein components of the cell

A preparation of ribonuclease has been made by Schlamowitz and Garner[3] from germinated soya beans We have made a survey of the ribonuclease contents of indigenous pulses and oil seeds readily available in the market, such as soya beans (*Glycine hispida*), Bengal gram (*Cicer arietinum*), green gram (*Phaseolus mungo*), horse gram (*Dolichos biflorus*), castor (*Ricinus communis*) and groundnut (*Arachis hypogaea*)

After soaking the seeds overnight in a stream of running water and germinating them in the dark for a period varying from 3 to 6 days until the seedlings measured 5 to 6 cm, the material was ground up in a porcelain end runner with glycerol sufficient to reach a 40 per cent concentration in the macerated mixture The extract was filtered through cloth after 48 hr autolysis in the cold and the ribonuclease activity of the crude filtrate was determined by the method of Kunitz A 1 0 per cent solution of purified yeast nucleic acid (B D H) in citrate buffer of *p*H 6 2 was employed as substrate 1 c c of the substrate was treated with 1 c c of crude glycerol preparation of the enzyme and the reaction was allowed to proceed at 37°C for 18 hr The reaction mixture was treated with 2 c c of uranyl acetate[4], allowed to stand for 30 min and filtered 2 c c of the clear filtrate were digested with 1 c c of 70 per cent perchloric acid according to the method of King[5] The digest was taken up with water, and transferred to a 50 c c volumetric flask 1 c c of 5 per cent aqueous ammonium molybdate solution and 0 5 c c of amidol solution were added and the mixture made up to 50 c c After 5 min the blue colour which developed was measured in a photoelectric colorimeter (Lumetron 402 E) using 630 M filter The phosphate contents were read off from a previously calibrated graph Reagent blanks and enzyme substrate controls were run and corrections applied in calculating the activity of the preparation

SOURCE OF ENZYME	MICROGRAMS OF P/C C.
G hispidia	100
C arietinum	75
P mungo	394
D. biflorus	112
R communis	430
A hypogaea	380

The results (TABLE I) show that *P mungo, R communis* and *A hypogaea* constitute rich sources of the enzyme Preparations from *R communis* and *C arietinum* have been found to be free from proteoclastic activity, a circumstance of great importance in securing ribonuclease preparations free from proteolytic enzymes

Our grateful thanks are due to the *Council of Scientific & Industrial Research* for financing the scheme of which this work forms a part

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BOUND TRYPTOPHANE IN PREPARATIONS OF PAPAIN

FOR A QUANTITATIVE ESTIMATION OF VITAMINS and amino acids of tissues and tissue fluids, suitable pre-treatment of the research material is essential for (1) releasing the bound vitamins and (2) for the hydrolytic liberation of amino acids from proteins Acids, alkalies and specific enzymes are generally employed for this purpose Acid hydrolysis results in a total or partial destruction of some of the amino acids Alkali, likewise, destroys amides, arginine, cystine and partially lysine and brings about a complete racemization of the amino acids Enzymes hydrolyse the materials into their constituent amino acids and liberate the bound vitamins, if present But one drawback with regard to the employment of enzymes for the hydrolysis of the protein is that the enzymes themselves may be associated with constituents to be assayed The preparation of enzymes should be (1) free from those constituents which are intended to be estimated and (2) free from interfering enzymes which may take the action to a further undesirable stage, involving the destruction of the amino acid or the vitamin under consideration Control experiments are usually carried out to account for (1) but an ideal enzyme preparation should be practically free from such constituents During our studies on the amino acid make up of virus-infected sandal leaf, the material was digested with a preparation of cyanide-activated papain, made according to the method of Ganapathi and Sastri[1] The preparation was found to be free from tryptophane as revealed by microbiological assays

It was, however, of interest to determine if tryptophane was present in the preparation in a bound and unavailable form The sample (1 gm) was hydrolysed with 12 per cent baryta for 24 hr on a sand bath and the baryta was thereafter removed as sulphate

The filtrate was concentrated under vacuum, the reaction adjusted to *p*H 6 8, made up to 25 c c and preserved under toluene at 0°C The total solids of the extract on total ash-free basis was 15 2 mg /c c

The tryptophane-free medium was composed of

Glucose 2 0 gm , sod acetate 2 0 gm , salts A and B 0 5 c c each , xanthine, uracil, adenin, guanin 1 mg each , B_1 50 γ , B_2 50 γ , B_6 100 γ , cal pantothenate 50 γ , niacin 100 γ , pab 10 γ , biotin 0 1 γ , folic acid 1 γ , cystine 20 mg , acid hydrolysate of casein 250 mg , *p*H 6 8 , volume made up to 50 c c

1 5 c c of the above medium was transferred to pyrex tubes, previously sterilized. For the development of the standard tryptophane curve the following levels of *dl*-tryptophane solution were added 1γ, 2γ, 3γ, 4γ, 5γ and the total volume in each tube was made up to 3 c c with distilled water

To the tryptophane-free medium the following levels of 1 3 diluted alkali hydrolysate of papain were added 0 1, 0 2, 0 4, 0 6, 0 8 and 1·0 c c and the final volume was made up to 3 c c with distilled water The tubes were steamed for half an hour

A 24-hr culture of *L arabinosus* (N C T C 2161) previously washed thrice with physiological saline and suspended in 50 ml of sterile saline was employed for inoculations, each tube receiving a drop of this suspension. The tubes were incubated at 37°C for 72 hr and the entire reaction mixture (3 c c) was titrated against N/20 NaOH using Brom-thymol-blue The results are graphically represented

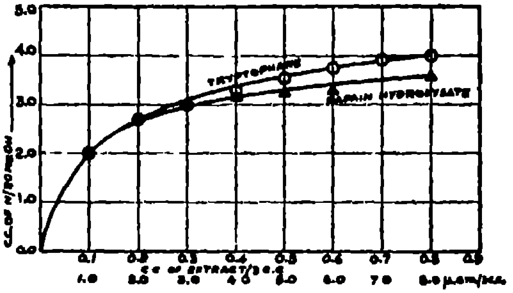

FIG 1 — GROWTH OF RESPONSE OF *L. arabinosus* TO ALKALI HYDROLYSATE OF PAPAIN

Discussion

1 *L arabinosus* which responds to free tryptophane is unable to utilize the bound tryptophane present in samples of papain, prepared according to the method of Ganapathi and Sastri[1]

2 The bound tryptophane in papain is, however, released on alkali hydrolysis and amounts to 0 2 per cent on the moisture and ash-free preparation

3 Preparations of papain can be used as an ideal hydrolytic agent for releasing tryptophane bound in proteins and for its subsequent estimation by *L arabinosus*

Our grateful thanks are due to the *Council of Scientific & Industrial Research* for financial support

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September 11, 1949

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A NOTE ON THE CONSTITUTION OF BIOCHANIN A

IN AN EARLIER COMMUNICATION[1] ON THE constitution of biochanin A, it was mentioned that a ketone, m.p , 160°C , provisionally named as biochanetin A, was obtained by a mild hydrolysis of biochanin A This ketone which analysed for $C_{15}H_{14}O_5$ (air dried sample) and which was characterized through a crystalline oxime m p 222° 23°C was presumed to be a trioxyphenyl 4-methoxybenzyl ketone On the basis of the constitution of biochanin A as 5 7 dioxy 4 methoxy*iso*flavone a ketone obtained by its mild hydrolysis should be identical with 2 4 6-trioxyphenyl 4-methoxybenzyl ketone m p 192° 93°C synthesized by Baker and Robinson[2] and also by Shriner and Hull[3] This ketone was also synthesized by the present authors for comparison and an air dried sample of it analysed for $C_{15}H_{14}O_5$ H_2O The water of crystallization could be completely removed only by prolonged heating at 100°C *in vacuo* over phosphorus pentoxide Thus biochanetin A proved to be different from the synthetic ketone

In a recent experiment in which a larger quantity of biochanin A (1 gm) was hydrolysed under slightly different conditions details of which will be published later two crystalline ketones were obtained by fractional crystallization of the phenolic part of the hydrolysis products through dilute alcohol The more soluble fraction yielded a ketone m p 160°C identical with biochanetin A The less soluble fraction on repeated crystallizations from dilute alcohol finally yielded a product m p 192° 93°C which analysed to $C_{15}H_{14}O_5$ H_2O On drying at 100°C *in vacuo* over phosphorus pentoxide for 5 hr it lost 1 molecule of water and analysed for $C_{15}H_{14}O_5$ It did not depress the melting point of a synthetic sample of 2 4 6-trioxyphenyl 4-methoxy benzyl ketone and thus proved to be identical with the latter With the isolation of this ketone through the hydrolysis of biochanin A a so far inexplicable point in regard to the constitution of biochanin A has been accounted for

Work on further elucidation of the constitution of the ketone biochanetin A is in progress

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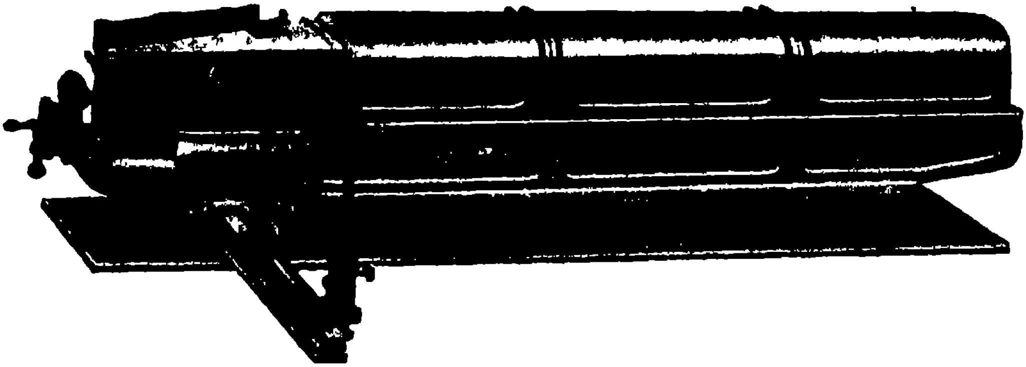

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Studies in the Chemotherapeutic Derivatives of Acridine Series: Part I—Some Derivatives of 2-iodo-7-methyl-9-substituted Aminoacridines

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A number of 2-iodo-7-methyl-9-substituted aminoacridines have been synthesized with a view to study their antiseptic properties 2-Iodo-7-methyl-9-chloracridine has also been condensed with *p*-anisidine, *p*-phenetidine, *p*-toluidine, 2-aminopyridine, 2-aminopyrimidine and *p*-xylidine Preliminary tests show that 2-iodo-7-methyl-9-aminoacridine inhibits the growth of *Staph aureus*, *B Coli*, *B flexner* and *B subtilis* in a dilution of 1 80,000

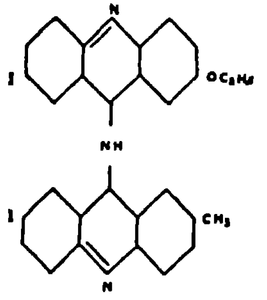
ACRIDINE derivatives have been successfully used in the treatment of various infections which include those due to *B coli*[1,2], *Proteus vulgaris*, *shiga*, *flexner*[3], *Brucella*[4], *Plasmodium vivax*[5], *P falciparm*, *Leshimonisis*[6], *Leptospira*[7] and the common pathogens, *Staph aureus*[1], and *Strept haemolyticus* Use of acriflavine and proflavine and, recently, of 9 amino acridine[8] has revolutionized the antiseptic surgery Since the introduction of atebrin by Mauss and Mietzsch[9] as an anti-malarial, several allied compounds have been synthesized, and some of them have been claimed to be more active plasmodicidal agents[10,11] Several compounds have been described by Singh *et al*[12–14] with nuclear variations of the chloro and methoxy groups in the atebrin molecule Nothing is known about their antimalarial properties, but the relative influence of various groups in the nucleus and of some substituents in position 9 on antiseptic activity have been described by Singh *et al*[3,15,16] in about 50 derivatives

In view of the high activity of some of these derivatives, particularly against Gram-negative organisms, the synthesis of some more derivatives of this series was undertaken for studying the influence of various groups in them on their antiseptic activity So far only one nuclear-substituted iodo acridine, namely 2 methoxy - 5 iodo - 9 - (δ di-ethyl amino α-methyl butyl) amino acridine, has been described in German patents by Mauss[17,18] and Mietzsch, and it has been claimed that it is an efficient agent for the cure of parasitic diseases of the blood It was, thus, of particular interest to synthesize some iodo derivatives and study the effect of iodine in the acridine series

Iodine and some of its organic combinations have been long used as external antiseptics More recently it has been shown that when the chloro group in " enterovioform " (chloro-iodo-hydroxy quinoline) is replaced by iodine, the resultant compound is a more useful therapeutic agent in the treatment of amoebic dysentery, as it is less toxic and better tolerated than " enterovioform "[19,20], while its activity is of the same order In the present work, therefore, 2-iodo-7-methyl-9-substituted amino acridines were synthesized, partly as a parallel to the many compounds described by Singh *et al* which contained a chloro group in position 2 or 7 The methyl substituent in position 7 has been selected particularly because of the findings of Albert and co-workers[21,22] to the effect that the introduction of the methyl group in this series yields products which are comparatively more basic in character and give fairly stable, soluble hydrochlorides

2-Iodo-7-methyl-9-chloroacridine was obtained by the ring closure of 5-iodo-5'-methyl-2-phenyl anthranilic acid with the help of phosphorus oxychloride, the intermediate acid being obtained by the condensation of 2 5-di-iodobenzoic acid with *p*-toluidine

2-Iodo-7-methyl-9-aminoacridine was obtained by adding ammonium carbonate to a hot phenolic solution of the corresponding 9-chloroacridine, according to the procedure of Albert and Gledhill[8] This was further condensed with 2-ethoxy-7-iodo-9-chloro and 2-chloro-7-iodo-9-chloroacridines, to give the bisacridyl compounds I and II These compounds are of special interest as both halves can be taken as substituted 9 amino acridines



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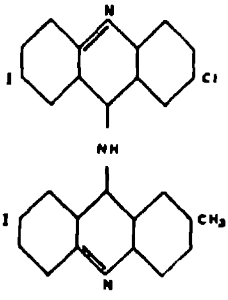

II

Further it has been shown that an unsubstituted amino group imparts the greatest antiseptic activity to the acridine molecule in position 9[8,16,22] and it was, therefore, of interest to observe the influence of the acridyl radical in this respect As an extension of this work 2-iodo-7-methyl-9-chloroacridine has also been condensed with *p*-anisidine, *p*-phenetidine, *p*-toluidine, 2-aminopyridine, 2-aminopyrimidine and *p*-xylidine

The results of studies of the antiseptic activities of the compounds referred to above will be published later It may, however, be stated here that 2-iodo-7-methyl-9-aminoacridine inhibits the growth of *Staph aureus*, *B coli*, *B flexner* and *B subtilis* in a dilution of 1 80,000 and that the compound II is as active as the parent amino acridine

Experimental

I 2 5-*Di-iodobenzoic Acid* — 53 gm of finely powdered 2-amino-5-iodobenzoic acid were dissolved in 300-350 c c of 12 per cent hydrochloric acid by warming, and then cooled slowly to room temperature The container was then placed in an ice bath and the contents stirred with a mechanical stirrer A solution of 22 gm of potassium nitrite in 100 c c water was then rapidly added to the acid solution (temp 5°-7°C) When the diazotization was complete, a little of the unreacted hydrochloride which had separated out in the course of the reaction was filtered off To the cold diazotized solution was added about 8-10 gm of urea to remove the excess of nitrous acid (no colour with starch-iodide paper) It is essential that there should be no free nitrous acid, as the iodine liberated by it is absorbed by the final product, which renders its purification difficult A solution of 40 gm of potassium iodide in 300 c c of water was then added drop by drop with stirring to the diazotized solution, when the iodo complex separated out as a brick-red precipitate Stirring was continued for another 30 min more after the potassium iodide solution had been added and the whole mass was then boiled for 2 hr The resultant light-brown to deep-yellow granular product was well washed with water The acid thus obtained was reprecipitated from its ammoniacal solution and crystallized from alcohol, when it came out in the form of brown rhombohydral crystals, m p, 182°-83°C (M W found 373, $C_7H_4O_2I_2$, requires 374)

II 5 *Iodo - N - p'methylphenylanthranilic Acid* — 4 gm of potassium metal were added in small bits to 40 c c of absolute alcohol, and 30 gm (1 mol) of 2 5 di-iodobenzoic acid were introduced into the resultant solution The mixture was refluxed in an oil bath at 120°C and 12 gm (1·5 mol) of pure crystallized *p*-toluidine and 15 gm (1 5 mol) of anhydrous potassium carbonate were added to it along with 0·1 gm of copper powder as catalyst After refluxing for 2-3 hr at 130°C, the reaction mixture was diluted with water, boiled (charcoal) and filtered hot On acidification with dilute hydrochloric acid, a deep-green precipitate was obtained which was dissolved in ammonia and reprecipitated with very dilute hydrochloric acid (Congo red) The acid thus obtained was filtered, dried and crystallized from glacial acetic acid, when it came out in light-green, rhombic plates (yield 27 gm, 95 per cent), m p ,218°-19°C (found N, 4 0 per cent, M W 351, $C_{14}H_{12}O_2NI$ requires N, 4 0 per cent, M W 353)

III 2 *Iodo-7-methyl-9-chloroacridine* — 15 gm of 5 iodo-N-*p*'-methylanthranilic acid were refluxed with 40 c c of phosphorus oxychloride on an oil bath at 120°C for 3-4 hr, and excess of phosphorus oxychloride distilled off under reduced pressure The contents of the flask were cooled in an ice bath and an ice-cold solution of dilute ammonia was added to it with constant stirring to liberate the base, which was filtered, washed with water and dried on a porous plate in a vacuum desiccator On crystallization from benzene, it was obtained in the form of golden-yellow needles melting at 151°-52°C in quantitative yield (found N, 4 0 per cent, $C_{14}H_{10}NICl$ requires N, 3 9 per cent)

IV 2 *Iodo-7-methyl-9-aminoacridine* — 1 gm of 2 iodo-7-methyl-9-chloroacridine was dissolved in 10 gm of phenol and heated at 70°C in an oil bath 1 gm of well-powdered ammonium carbonate was then rapidly added to the solution with constant stirring and the temperature of the bath was raised to 120°C After heating for about half an hour in the course of which effervescence had ceased, the resultant solution was cooled and ether added to it to precipitate the hydrochloride of the base A few drops of alcoholic hydrochloric acid were added to it to ensure complete precipitation The hydrochloride thus obtained was crystallized from absolute alcohol when it formed prismatic plates which were sparingly soluble in alcohol, even more sparingly so in water, and melted at 330°C The alcoholic solution of the hydrochloride exhibits greenish-yellow fluorescence The base was liberated by treating the hydrochloride with 10 per cent sodium hydroxide in the hot On crystallization from absolute alcohol and acetone, the base formed yellow needles sparingly soluble in alcohol and other organic solvents, m p, 291°-92°C (found N, 8 2 per cent, $C_{14}H_{11}N_2I$ requires N, 8 4 per cent)

V 2-*Iodo-7-methyl-9-amino-(2'Iodo-7'-chloroacridyl) Acridine* — 2 Iodo-7-methyl-9-aminoacridine (1 mol) was added to 2-iodo-7 9-dichloroacridine (1 mol) dissolved in phenol at 70°C The solution was heated as usual on a water bath for 4 hr and then ether added on to it, when the hydrochloride of the bisacridyl derivative precipitated out as a yellow powder It was crystallized from a large volume of absolute alcohol when it came out in greenish-yellow needles, m p, 348°-49°C, very sparingly soluble in all the usual solvents (found N, 5 85 per cent, $C_{27}H_{18}N_3ClI_2$ requires N, 6 26 per cent)

VI 2-*Iodo-7-methyl-9-(2'iodo-7'-ethoxy-acridyl)-aminoacridine* — This was prepared in exactly the same manner as described above, using 2 iodo 7-ethoxy-9-chloroacridine The hydrochloride separated out as greenish-yellow powder, and crystallized from absolute alcohol in bright-yellow needles, m p, 305°C (found N, 5 79 per cent, $C_{29}H_{21}ON_3I_2$ requires N, 6 15 per cent)

VII 2-*Iodo-7-methyl-9-(p'-methoxyphenyl)-aminoacridine* — 1 gm (1 mol) of 2 iodo-7-methyl-9-chloro acridine was dissolved in 6 gm of phenol by heating it on a water bath and 0 4 gm (1 5 mol) of *p*-anisidine was added to it The reaction mixture was heated for 4 hr at 100°C and diluted with ether after cooling The crude hydrochloride thus obtained was well washed with ether and acetone and crystallized from glacial acetic acid, when it formed slender yellow needles, m p, 290°-91°C

The free base liberated from the hydrochloride with 5 per cent sodium hydroxide in the hot, crystallized from absolute alcohol and acetone in yellow needles, m p, 210°C

Condensation of 2-iodo-7-methyl-9-chloro acridine with *p*-phenetidine (VIII), *p*-toluidine (IX), 2 aminopyridine (X), 2 aminopyrimidine (XI) and 2-amino 1, 4 dimethyl benzene (XII) was carried out in exactly the same manner as described in the case of *p*-anisidine (*see* TABLE I)

Acknowledgement

We wish to express our thanks to Dr S Siddiqui for the keen interest taken by him during the work

TABLE I — 2 IODO-7-METHYL-9-AMINOACRIDINE

	SUBSTITUENT AT POSITION 9	M P OF		FORMULA	PERCENTAGE NITROGEN	
		Base °C.	Hydrochloride °C		Found	Calc.
1	p-methoxyphenyl amino (VII)	210	290 91	$C_{21}H_{17}ON_2I$	6 29	6 36
2.	p ethoxyphenyl amino (VIII)		302	$C_{22}H_{19}ON_2I$	5 9	6 16
3	p-methylphenyl amino (IX)	225	310 11	$C_{21}H_{17}N_2I$	6 82	6 60
4	α aminopyridine (X)	230-32	298	$C_{19}H_{14}N_3I$	9 98	10 20
5	α amino pyrimidine (XI)	265	305 07	$C_{18}H_{13}N_4I$	13 85	13 59
6.	1 4 dimethyl phenyl 2 amino (XII)	254	288-90	$C_{22}H_{19}N_2I$	6 31	6 40

NOTE All these compounds are sparingly soluble in water and organic solvents.

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Studies on Shark Liver Oil: I—Concentration of Vitamin A by Cyclic Distillation & Chemical Composition of the Oil & Its Fractions

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Batches of shark liver oil were fractionated in a cyclic molecular still of the falling film type at distillation pressures of 0-5 microns Elimination curves were obtained representing (a) per cent yield of distillate and of vitamin A in different fractions, and (b) vitamin A potency per gram of each fraction. A thirty-fold concentration of the vitamin was obtained with three cycles at 180°-200°C.

The mixed fatty acids of the whole as well as fractionated oils were separated into the saturated and unsaturated components and the latter characterized Unsaturated fatty acids constituted 55-70 per cent of the total mixed fatty acids and were highest in the residual oil and lowest in the fraction collected between 180°-200°C

COMMERCIAL production of vitamin A by synthesis has been a recent development[1-4] and fish liver oils, therefore continue to be the main source of the vitamin Its concentration by molecular distillation[5] has been put widely into practice by the patentees[6-8] who hold the monopoly for the process An account is given here of the results obtained on the distillability of vitamin A from lots of Indian shark liver oil using a laboratory type of this still and of the physical and chemical constants of the distillate fractions

Experimental

Apparatus, Materials & Methods — The apparatus used was a cyclic falling film still, DPI, type CMS-1,000, which is an improvement of the one described by Hickman[9]

Vitamin A determinations were made by tintometric (Lovibond) or spectrophotometric (Klett-Summerson) measurement of the blue colour with the Carr-Price reagent[10] Conversion of blue units per gram of oil to international units was effected by use of the factor 3 based on the average of ratio obtained from biological assays[11]

The samples of shark liver oil used were either prepared in the laboratory from fish livers by the process of Sarangdhar[12] or obtained from the Director of Fisheries, Bombay

Working of the Still — Preliminary degassing of each charge was done by regulating the speed with which the distillant was admitted to the upper reservoir of the still under evacuation by the fore pump alone The liquid, once taken in, was allowed to run down into the lower reservoir and then pumped upwards through the pre-heating tube whence it spread over the evaporator Both pre-heater and the evaporator were heated to 60°-100°C to assist in the final degassing Usually one complete cycle over the evaporator with a distilling temperature of 60°-100°C and a pressure of 50-100 microns was sufficient for complete degassing Degassed material was kept separated by setting the ball valve between the reservoirs

When the oil had been degassed and the Pirani gauge indicated a steady pressure, the Booster pump was started followed, a few minutes later, by the condensation pump In the interim, the feed rate was adjusted to 7-8 min per 100 c c of the oil by raising or lowering the magnet jaws as necessary The heat input to the evaporator and pre-heater were slowly altered until a desired distillation rate for the first cut was obtained The heater voltage was then so adjusted that the distilling temperature was at the closest 10°C mark and subsequent fractions were taken at suitable (20°C) intervals The pre-heater temperature was maintained 20°-30°C below that of the evaporator

Preliminary Tests — To study the concentration of vitamin A from Indian shark liver oils by the falling film cyclic still, several pilot distillations were carried out 300-400 gm lots of the oil, free from moisture, dust or other tissue particles, were taken Each cycle usually took 40-50 min and the working pressure maintained was 0-5 microns 4 fractions were collected in the order (i) below 180°C , (ii) 180°-200°C , (iii) 200°-20°C , and (iv) 220°-40°C , these temperatures were fixed after trials not reported here Representative results are given in Table I

TABLE I — DISTILLABILITY OF VITAMIN A IN SHARK LIVER OIL

Batch 1*

Fraction	Yield gm	Potency I U /gm	Total potency I U
Original shark liver oil	185 5	21,750	40,34 625
Below 180°C	10 5	43,500	4,56,750
180°-00°C	9 3	1 21,500	11 29 950
200° 20°C	43 0	45,000	19,35,000
220° 40°C	34 5	18 750	6,87,500
Residual oil	72 3		

NOTE Total vitamin A recovered = 41,49 200 I U

% loss in (i) oil recovery = 8 1

(ii) potency = nil

*Oil extracted in the laboratory

Fraction collected between 180°-200°C gave the highest vitamin A potency which in different batches varied from 5 to 18 times that of the original oil To get higher concentrates of vitamin A, the period for each cycle was reduced to 35-40 min and the oil was cyclized more than once at each temperature range except for the last fraction (220°-40°C) Under these conditions, a thirty-fold concentration of vitamin A could be effected Representative data are given in Table II

There exists no relation between the yield of the concentrate at definite temperature ranges and their corresponding potencies With all batches, however, more than 50 per cent of the vitamin A is recovered in the fraction collected between 180°-200°C A single cycle at this temperature range gives about 30-33 per cent recovery of vitamin A With 3 and 4 cycles, recovery amounts to about 60 per cent and 70 per cent respectively of the total Recovery is, therefore, greater as the number of cycles are increased

Attempts were made to increase the number of cycles at this particular temperature range (180°-200°C) to get the highest possible recovery of vitamin A but there was practically no distillate yielded after cyclizing 4 times Concentrates of the first two fractions were very viscous and a hot air blower had to be employed in collecting these

In the experiments reported hitherto, the distillates were collected in the same sample bottle with repeated cyclization at the same temperature range and the potencies of the mixed distillate at each temperature range were measured In the following experiments (TABLE III), the distillations were carried out as before but the fractions, at the same temperature range in each of the different cycles, were collected separately.

Successive cyclization at the same temperature range under identical conditions of distillation yields decreasing amounts of the concentrates This observation does not hold good when the temperature of distillation is below 180°C , where the distillate

TABLE II — CYCLIC DISTILLATION OF SHARK LIVER OIL

Batch 5*

Fraction	No of cycles	Nature & colour of distillate	Yield gm	Potency I U /gm	Total potency I U
Original shark liver oil		Reddish brown liquid	490 0	25,000	1,22,50,000
Below 180°C.	2	Deep reddish brown, semi-solid	7 0	1,83,750	12,86,250
180° 200°C.	3	Reddish brown viscous liquid	13 0	5,25,000	68,25,000
200° 20°C	2	Yellow with slight reddish tinge, liquid	30 0	1,15,000	34,50,000
220° 40°C	1	Pale yellow liquid	50 0	11,875	5,93,750
Residual oil		Dark brown liquid	378 7		

NOTE Total vitamin A recovered = 1,21,55,000 I U

% loss in (i) oil recovery = 2 3

(ii) potency = 0 81

* Courtesy Director of Fisheries, Bombay

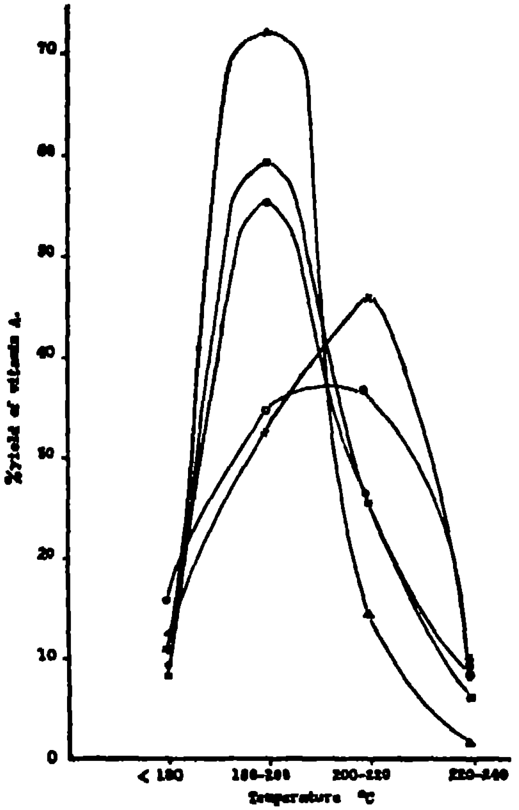

FIG 1 — PER CENT YIELD OF VITAMIN *versus* TEMPERATURE

O-O-O, Batch 3, ×-×-×, Batch 4, Δ-Δ-Δ, Batch 6, □-□-□, Batch 8, ●-●-●, Batch 9

collected during the second cyclization is more potent This would mean that below 180°C, with recyclization, less of inert material distils off with vitamin A, the reverse being true above 180°C

Elimination Curve — The expression of the intrinsic rate of distillability as an elimination curve has been discussed by Hickman[13] and by Embree[14] Such curves derived from protocols similar to those in Tables I to III are given in Figs 1 to 3 and relate to (i) the percentage yield of vitamin A in each fraction, (ii) vitamin content per gram of each fraction, and (iii) percentage yield of distillate, all of them plotted against the temperature of distillation

Maximum yield of the vitamin is obtained at the temperature range 180°-220°C, but with increase in rate of distillation and repeated cyclization, the curves are shifted to the left giving a maximum vitamin yield at lower temperature (180°-200°C) and showing, therefore, that substances have no fixed boiling points in high vacuum[13]

Chemical Composition of the Oil & Its Molecularly Distilled Fractions

Qualitative information on the fatty acids of fish oils has been given by Tsujimoto[15] and Toyama and Tsuchiya[16] Hilditch and Houlbrooke[17] have made a study of the composition of fatty acids present as glycerides in *Elasmobranch* oils Analytical data relating to shark liver oils are reported by Kini[18] and by Gajjar[19]

The studies reported here were undertaken primarily with a view to ascertaining the relationship, if any, between the relative rates of vitamin A destruction on the one hand and the composition of the oil and of

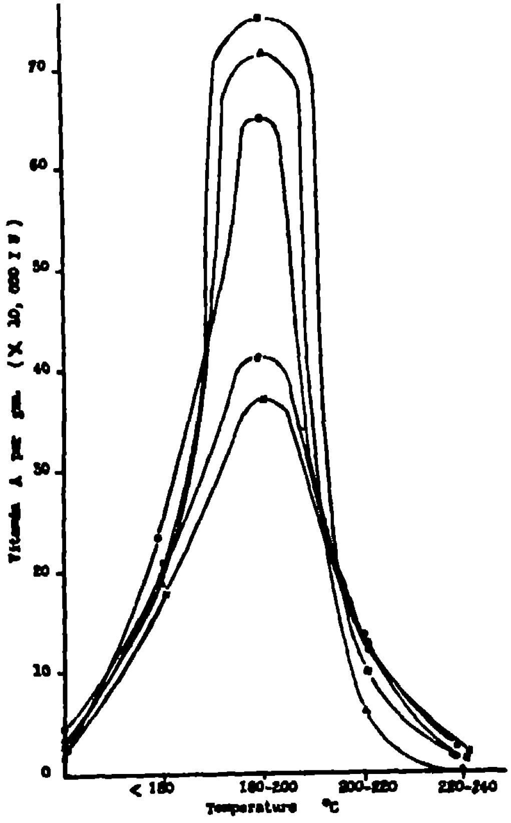

FIG 2 — POTENCY (VITAMIN A PER GRAM) *versus* TEMPERATURE

O-O-O, Batch 3, ×-×-×, Batch 4, Δ-Δ-Δ, Batch 6, □-□-□, Batch 8, ●-●-●, Batch 9

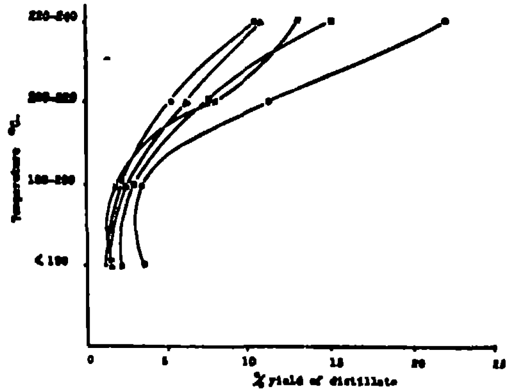

FIG 3 — PER CENT YIELD OF DISTILLATE *versus* TEMPERATURE

O-O-O, Batch 3 ×-×-×, Batch 4, □-□-□, Batch 8, Δ-Δ-Δ, Batch 6, ●-●-●, Batch 9

its various molecularly distilled fractions on the other

Specific gravity and refractive index determinations were made using a pyknometer and a Billingham and Stanley refractometer respectively Melting points were ascertained by the pellet method of Koch *et al*[20] Iodine values were determined employing the pyridine sulphate bromide method of Bolton[21] and peroxide numbers by Wheeler's procedure[22] *A O C S* methods were adopted for acid and saponification values and for the determination of non-saponifiable matter[23]

The soap solution, after extraction of the unsaponifiable fraction, was used for the separation (by addition of acid) of the mixed fatty acids, the latter being extracted by successive small amounts of ether The mixed fatty acids were then separated into "solid" and "liquid" fatty acids by Twitchell's procedure[24] The melting points, iodine numbers and acid values of the fatty acids were determined as above Mean molecular weights of the saturated and unsaturated fatty acids were calculated from the corresponding acid numbers by use of the formula $M = \frac{1000}{a}$, where M is molecular weight in grams and *a* is number of c c of normal potassium hydroxide required to neutralize 1 gm of fatty acid

All determinations were carried out in duplicate

Results — The data obtained with a sample of shark liver oil and its molecularly distilled fractions are recorded in Tables IV and V

Specific gravity decreases with increase in boiling point of the distillate except for the residual oil which has got the highest specific gravity The melting point of the fraction distilling between 180°-200°C is the lowest while the fraction distilling below 180°C has the highest melting point Since the potency

TABLE III — CONCENTRATION OF VITAMIN A IN INDIVIDUAL CYCLES

Batch 10*

FRACTION	CYCLE	TIME min	NATURE & COLOUR OF DISTILLATE	YIELD gm	POTENCY I U /gm	TOTAL POTENCY I U	TOTAL POTENCY I U for each stage
Original shark liver oil			Reddish brown liquid	492 0	28,000	1,37,76,000	1,37,76,000
Below 180°C	1st	35	Deep reddish brown, semi solid	3 5	1,95,000	6,82,500	
	2nd	35	do	2 2	4 12,500	9,07,500	15,90,000
180° 200°C	1st	34	Reddish brown viscous liquid	3 8	7 20 000	26,79,000	
	2nd	34	do	3 2	7,05,000	22,56,000	
	3rd	33	do	3 2	7,05,000	22,56,000	71,91,000
200° 20°C	1st	32	Yellow with slight reddish tinge, liquid	13 5	1 44 000	19,44,000	
	2nd	31	do	11 0	1,19,000	13,09,000	32,53,000
220° 40°C,	1st	30	Pale-yellow liquid	61 2	23,625	14,41,125	14,41,125
Residual oil			Dark brown liquid	383 5			

NOTE Total vitamin A recovered = 1,35 23,125 I U

% loss in (i) oil recovery = 1 42

(ii) potency = 1 82

* Oil extracted in the laboratory

of vitamin A in the fraction distilling between 180°-200°C is the highest, it would follow that the vitamin A is associated mainly with the non-stearine fraction of the fish oil This fraction also has the highest refractive index The free fatty acids content is the highest in the fraction distilling below 180°C A comparison of the acid values for the various fractions with the original oil would suggest that there has been an amount of dissociation of glycerides during distillation, particularly in fraction distilling below 180°C The percentage of unsaturated fatty acids in the glycerides is the lowest in the fraction distilling between 180°-200°C Saponification value is low and the unsaponifiable fraction high in the distillate below 180°C, while the corresponding values for the fractions distilling between 180°-240°C are intermediate between these values and those for the original and the residual oils Peroxide number is high in the fraction 180°-200°C corresponding to the original oil while with residual oil it is low Iodine value of unsaponifiable matter is the highest in fraction distilling up to 200°C and the lowest in the fraction distilling beyond 200°C

In general it would seem that the physical and chemical characteristics of the fraction distilling below 180°C are rather distinct from those distilling above this temperature

A comparison between the characteristics reported here and the distribution as well as stability of vitamin A in the various fractions is made in a further communication

Summary

(1) Batches of shark liver oil have been fractionated in a cyclic molecular still of the falling film type Distillation pressure was maintained at 0-5 microns The fractions collected were (i) below 180°C, (ii) 180°-200°C, (iii) 200°-20°C, and (iv) 220°-40°C, limiting to one cycle for each fraction Fraction 180°-200°C was the most potent in vitamin A content Concentration of vitamin A obtained was 5-18 times The different batches of oil behaved alike in respect of their vitamin A fractionation

(2) Repeated cyclization was carried out at each temperature range except for the last fraction (220°-40°C) to get higher concentration of vitamin A A thirty-fold concen-

TABLE IV — PHYSICAL & CHEMICAL CONSTANTS OF MOLECULARLY DISTILLED FRACTIONS INCLUDING ORIGINAL & RESIDUAL OILS

FRACTION	SP GR AT 28°C	M P (°C)	REF INDEX AT 28°C	ACID NUMBER (mg /gm)	IODINE VALUE (gm./100gm)	SAP NUMBER (mg /gm)	UNSAPONIFIABLE MATTER, %	PEROXIDE NUMBER (millimoles, kg)	IODINE VALUE OF UNSAPONIFIABLE MATTER (gm./100 gm.)
Original shark liver oil	0 9124	19 0	1 471	1 11	114 21	177 3	6 74	14 21	50 2
Below 180°C.	0 9219	26 5	1 488	38 83	119 28	64 2	40 90	5 38	131 9
180° 200°C.	0 9193	17 0	1 491	8 51	121 18	133 2	31 02	14 00	128 5
200° 20°C.	0 9128	23 0	1 472	3 30	88 57	121 7	37 52	5 78	81 9
220° 40°C	0 9084	22 0	1 467	2 85	85 53	130 9	33 97	4 16	58 0
Residual oil	0 9257	18 0	1 471	2 91	118 65	181 3	3 11	1 95	59 9

TABLE V — PHYSICAL & CHEMICAL CONSTANTS OF MIXED, SATURATED & UNSATURATED FATTY ACIDS OF MOLECULARLY DISTILLED FRACTIONS INCLUDING ORIGINAL & RESIDUAL OILS

FRACTION	MIXED FATTY ACIDS			SATURATED FATTY ACIDS					UNSATURATED FATTY ACIDS			
	Mixed fatty acids, %	M P (°C)	Iodine value (gm./ 100 gm)	% of mixed fatty acids	M P (°C)	Iodine value (gm / 100 gm)	Acid number (mg / gm)	Mean molecular weight	% of mixed fatty acids	Iodine value (gm / 100 gm)	Acid number (mg./ gm)	Mean molecular weight
Original shark liver oil	86 82	36 0	99 46	41 62	50 0	18 96	209 6	267 1	60 29	122 78	167 2	334 8
Below 180°C.	62 60	38 0	84 05	44 80	51 5	14 00	210 0	266 6	57 93	134 20	100 5	558 3
180° 200°C	56 00	41 0	141 64	47 81	52 0	7 98	212 8	263 6	58 40	104 82	90 1	621 5
200° 20°C.	56 04	40 0	56 40	45 09	49 0	8 97	214 2	261 3	56 00	102 98	198 1	290 0
220° 40°C	59 40	39 0	72 96	35 50	54 0	6 50	215 8	259 5	67 70	90 64	193 4	289 5
Residual oil	89 76	35 5	109 80	33 66	52 0	8 82	206 0	269 2	71 70	135 96	164 6	340 4

tration of the vitamin was obtained with three cycles at 180°-200°C

(3) The distillates at the same temperature range in each of the different cycles were collected separately and their potencies measured It was observed that the fraction below 180°C collected during second cyclization was more potent in vitamin A content than the one collected during the first cycle, above 180°C the potency of the fractions decreased in the order in which they were collected

(4) Successive cyclization at the same temperature range yielded decreasing amounts of distillates There was no relation between the weight of the oil taken, the yield of fractions and the potency of vitamin A at each temperature range for different batches of oil

(5) Elimination curves are shown representing (a) per cent yield of vitamin A in each fraction, (b) vitamin A content per gram of each fraction, and (c) per cent yield of distillate, all of them plotted against distillation temperature

(6) A detailed examination is reported of the physical and chemical constants of shark liver oil and its molecularly distilled fractions including the residual oil

(7) The mixed fatty acids of the whole as well as fractionated oils were separated into the saturated and unsaturated components and the latter studied for their characteristics Unsaturated fatty acids constituted 55-70 per cent of the total mixed fatty acids and were highest in the residual oil and lowest in the fraction collected between 180°-200°C

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Autoxidation & Keeping Quality of Lemon-Grass Oil & the Influence of Some Antioxidants on the Stabilization of Citral in It

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Lemon-grass oil is susceptible to the loss of citral and germicidal property on storage The rate of deterioration is comparatively faster in purified oil than in crude oils

Lemon-grass oil is subject to easy autoxidation. The amount of oxygen absorbed by lemon-grass oils during storage has been quantitatively measured at different stages of autoxidation and it has been demonstrated that the fall of citral and bactericidal potency is principally due to the autoxidation of the oil

The comparative efficiency of a large number of antioxidants has been determined with reference to lemon-grass oil by measuring the "induction period" of the oil treated with and without antioxidants by the accelerated oxygen-absorption method The synergetic effect of suitable combinations of antioxidants has also been studied

Ethyl or *n*-propyl gallate, in conjunction with citric or tartaric acid, appear to be the best antioxidants so far examined.

ESSENTIAL oils are susceptible to autoxidative deterioration and tend to deteriorate in colour and perfume and lose their active constituents during storage These changes are rapid under tropical conditions The autoxidation of essential oils is believed to be due to a breakdown at the double bonds of the unsaturated constituents with the formation of oxidation and decomposition products

During the course of our investigation on the germicidal property of lemon-grass oil, it was observed that lemon-grass oils deteriorated in their citral content and delicate perfume on keeping and the bactericidal efficiency of the disinfectant preparations made out of stored oils was appreciably lower than that of the original oils In a previous communication[1] it has been shown that the citral content of lemon-grass oil and its disinfecting power are very closely related and that all other conditions being identical, the latter is directly proportional to the concentration of the former.

With a view to finding out the principal cause of the deterioration of citral in lemon-grass oil as also of the concomitant loss of its germicidal power and perfume, experiments on the autoxidation of lemon-grass oil have been conducted and it has been demonstrated that the oil is subject to easy autoxidation resulting in the loss of citral and bactericidal potency Attention has been directed to prevent or arrest this destructive autoxidation of the oil and to stabilize the citral in it

The use of antioxidants in fixed oils and fats is common and it appears that equally good effects may result from their use in essential oils The chemical antioxidants for fats and oils can be broadly classified as (1) *acid-type*, viz several organic and inorganic acids[2] like citric, ortho-phosphoric, etc , (2) *phenolic*, viz hydroquinone[3], pyrogallol[4], gallic acid and alkyl gallates[5] and a host of others and (3) *nitrogenous*, viz amino acids[6] like tyrosine, glycine, etc , and their esters and aromatic amines[4, 7] Among the natural antioxidants, cereal flours[8], especially oat and soya-bean flours and their extracts, have gained more prominence

Very little work has been done on the practical application of antioxidants in preventing deterioration of essential oils. Pyrogallol and hydroquinone have been found to be capable of preventing oxidation of turpentine oils[9] A mixture of wheat germ oil and hydroquinone is very effective in retarding the oxidative deterioration of lemon and orange oils[10] Addition of catechol to peppermint oil[11] has been reported to prevent the loss of the chief constituent, menthol Chlorophyll has been mentioned[12] as a suitable antioxidant for citral Crude cane or beet sugar has been reported[13] to have stabilizing action on essential oils Musher[14] has recommended the use of extracts from divided oats, maize or barley

The synergetic effect of certain mixtures of inhibitors has also been reported The synergetic effect is generally achieved[3,15] by the use of a combination of an antioxidant of phenolic character with an acid-type inhibitor Combinations of antioxidants such as those (a)[16] of a phosphorus compound like phosphoric acid and a polyhydroxy benzene or (b)[17] of a sugar[18] and a phenolic compound have been found to exert synergetic action on the stabilization of essential oils

In addition to having high antioxygenic power, an antioxidant for lemon-grass oil to be used in disinfectants must be sufficiently soluble or dispersible in it, should maintain the original content of citral without affecting its normal colour and perfume and without exerting any toxic action to the human tissue and should be easily available and cheap In the present study, the comparative efficiency of some of the commonly used and cheap antioxidants, singly as well as in suitable combinations, have been assessed with reference to lemon-grass oil and to the stabilization of its active constituent, citral

Experimental

Two crude samples of lemon-grass oil which were freshly distilled on a commercial scale were filled in brown glass-stoppered bottles and stored at room temperature (18°-35°C) Portions of the same samples were again steam-distilled under laboratory conditions, dried over anhydrous sodium sulphate and stored under identical conditions The samples were kept under observation for two years and periodically examined for citral content and Rideal-Walker coefficient Citral was estimated by the standardized method of hydroxylamine hydrochloride[19] As mentioned in the previous communication[20], emulsions were prepared under identical conditions by using 1 per cent of the oil to be tested, 1 per cent potassium oleate as the emulsifying agent and 0 5 per cent potassium carbonate as the stabilizer and examined for the R-W coefficient against *B typhosus* The results are given in Table I

As mentioned before, the loss of citral and germicidal potency in lemon-grass oil on storage may be due to autoxidation taking place in the oil With a view to demonstrating the influence of autoxidation on the citral content and bactericidal efficiency of the oil, experiments on oxygen absorption were carried out under controlled conditions

A simple apparatus was set up for measuring directly the exact volume of oxygen absorbed in an oil A conical flask (250 c c) with a circular lip for mercury seal was connected by a ground-in-glass stopper to a two-way stop-cock This was conveniently made from an iodination flask by opening the seals of both the top and the bottom of the ground-in-glass stopper and connecting its top to a two-way stop-cock One arm of the stop-cock was bent and connected to the bent top of a graduated tube, held perpendicularly, which was obtained from the graduated section of a 25 c c burette The tube was sealed at the lower end and was attached near the bottom to a side tube which was connected by a suitable length of pressure tubing to an adjustable-height mercury bulb

5 gm of oil were accurately weighed into the flask which was then closed and mercury-sealed The flask as well as the graduated

TABLE I — FALL OF CITRAL & GERMICIDAL POTENCY IN LEMON-GRASS OIL ON NORMAL STORAGE

LEMON GRASS OIL	PERIOD OF STORAGE										
	Nil		6 months		12 months		18 months		24 months		
	Citral %	R W coeff	Citral %	R W coeff	Citral %	R W coeff	Citral %	R W coeff	Citral %	R W coeff.	Loss of citral, %
(9) Crude	78 28	12 5	71 70	9 5	62 14	6	51 01	3	39 15	1	49 9
(9A) Re steam distilled	84 20	16 5	75 66	12	63 21	8	48 80	5		1	58 7
(10) Crude	82 04	14	74 49	12	65 41	9	52 80	5	41 28	2	49 6
(10A) Re steam distilled	87 43	17 5	77 50	13	64 09	10	48 93	6 5	35 81	2	59 0

TABLE II — OXYGEN ABSORPTION & LOSS OF CITRAL & GERMICIDAL POTENCY IN CRUDE & PURIFIED LEMON-GRASS OILS : 5 GM. OF OIL USED

Period of exposure, hr	Weight of oxygen absorbed, gm	Citral %	R W coeff
Sample 8, crude (I P 35 min)			
0		78 28	12 5
43 5	0 0359	67 91	10
84	0 0735	55 23	8
136	0 1088	40 01	5
185	0 1472	24 58	2 5
236	0 1813	11 41	<1
Sample 3A, purified (I P 25 min)			
0		84 20	16 5
31	0 0349	71 49	15
58	0 0719	56 28	12
87	0 1097	39 85	7
129	0 1491	24 55	3 5
186	0 1831	14 05	<1
Sample 10, crude (I P 40 min)			
0		82 04	14
45	0 0386	72 19	13
88	0 0777	59 33	10
141	0 1130	42 81	6
186	0 1517	27 57	3
248	0 1874	16 83	1
Sample 10A, purified (I P 35 min)			
0		87 43	17 5
30 5	0 0376	75 04	15
55 5	0 0772	59 18	12
88	0 1127	41 43	8
128	0 1506	25 25	3
194	0 1897	12 25	<1

* I P — the period during which there is no absorption of oxygen

tube were evacuated to a very low pressure from a Cenco pump and then filled with oxygen The flask was half immersed in an oil thermostat previously adjusted at 37°C ± 0 2 Any excess pressure was released by momentarily opening the stop-cock With the absorption of oxygen, the mercury column gradually rose up The heights of the mercury column (after being adjusted for atmospheric pressure) and barometric readings were noted at suitable intervals and the weight of oxygen absorbed was calculated

A possible disadvantage of this method is that the rate of oxygen absorption may be influenced by pressure changes To obviate this, the system was periodically re-adjusted by admitting more oxygen into the reaction flask and occasionally the flask was taken out of the oil bath, evacuated after cooling the oil and refilled with oxygen To test whether the absorption of oxygen is complete, the flask was evacuated and refilled with fresh oxygen.

The loss of citral and germicidal potency in the oil were studied at five different stages of autoxidation In the first experiment of each set, the sample of oil was allowed to absorb the maximum amount of oxygen and in the other four experiments the periods of exposure were so controlled as to obtain four samples of oil saturated with approximately one-fifth to four-fifths of the total amount of oxygen absorbed in the first sample Each sample was analysed for citral content and R-W coefficient as before The results are given in Table II In all the experiments the initial period during which there was no absorption of oxygen was also noted

It is obvious from the above table that as the absorption of oxygen proceeds, the citral content and bactericidal efficiency of the oil deteriorate

The influence of most of the acid-type, phenolic and nitrogenous antioxidants on the retardation of autoxidation of lemon-grass oil was studied by measuring the induction period of the oil treated with and without antioxidants by the oxygen-absorption method[15] To accelerate the rate of oxygen absorption, thin layers of oil were exposed to oxygen in a closed system and maintained at 37°C ± 0 2 under the usual thermostatic control The rate of oxygen absorption was recorded by means of pressure changes as indicated by an open-type mercury manometer

Most of the phenolic antioxidants were soluble in the oil and others which were insoluble were suspended in it in a fine state of division by trituration in a mortar The

TABLE III — EFFECT OF SOME ANTIOXIDANTS ON AUTOXIDATION OF LEMON-GRASS OIL

Antioxidants added & concentration, %	Induction period, min	Protection factor
Control	35	
Oxalic acid (0 06)	40	0 14
Citric acid (0 06)	110	2 14
Tartaric acid (0 06)	115	2 28
Malonic acid (0 06)	50	0 42
Maleic acid (0 06)	35	0 00
Succinic acid (0 06)	40	0 14
Salicylic acid (0 06)	35	0 00
Ortho-phosphoric acid (0 06)	55	0 57
Glycine (0 06)	35	0 00
Glutamic acid (0 06)	70	1 00
Tyrosine (0 06)	35	0 00
Cane sugar (0 06)	45	0 28
Resorcinol (0 06)	40	0 14
α naphtho (0 06)	50	0 42
β-naphthol (0 06)	35	0 00
Hydroquinone (0 06)	205	4 85
Pyrogallol (0 06)	325	8 28
Pyrocatechol (0 06)	165	3 71
Phloroglucinol (0 06)	75	1 14
Thymol (0 06)	85	1 42
Tannic acid (0 06)	115	2 28
Gallic acid (0 06)	125	2 57
Methyl gallate (0 06)	155	3 42
Ethyl gallate (0 06)	290	7 28
n-propyl gallate (0 06)	270	6 71
n-butyl gallate (0 06)	255	6 28
Iso-butyl gallate (0 06)	225	5 42
n-amyl gallate (0 06)	180	4 14
Iso-amyl gallate (0 06)	190	4 42

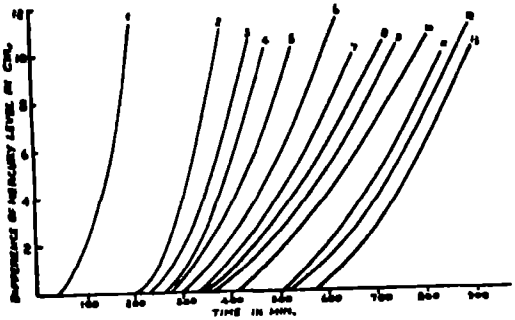

FIG 1 — RETARDATION OF AUTOXIDATION IN LEMON-GRASS OIL BY ANTIOXIDANTS

1 Control, 2 hydroquinone (0 006%), 3 *iso*-butyl gallate (0 006%), 4 *n*-butyl gallate (0 006 %), 5 *n*-propyl gallate (0·006%) 6 ethyl gallate (0 006%), 7 pyrogallol (0·006%), 8 hydroquinone (0·06%)+ citric acid (0·03 %), 9 *iso*-butyl gallate (0·06%) + citric acid (0·03%), 10 *n* butyl gallate (0 06%) + citric acid (0·03%), 11 *n*-propylgallate (0·06%) + citric acid (0·03%). 12 ethyl gallate (0 06%) + citric acid (0·03%) and 13 pyrogallol (0·06%) + citric acid (0 03%)

same sample of re-steam distilled oil (citral content, 87 43 per cent) was used throughout all the experiments on antioxidants The induction periods were determined from the curves drawn with time in minutes as abscissae and the difference of mercury levels in cm as ordinates The protection factor was calculated as the ratio of the induction period of the oil treated with antioxidant to that of the untreated oil minus one The results are summarized in Table III and a few of the important curves are shown in Fig 1

With a view to studying the synergetic action of antioxidants on lemon-grass oil, a few promising antioxidants were chosen from Table III and the suitable mixtures were tested for their efficiency as before. The results are summarized in Table IV and a few of the important curves are shown in Fig 1

Experiments, as conducted above, on the absorption of oxygen by the oil and its retardation by the incorporation of a single or mixtures of antioxidants provide a rapid method for assessing and comparing the efficiency of antioxidants Further, to determine to what extent protection is afforded by these antioxidants to stabilize citral in the oil, the results of the above experiments were applied to the storage of lemon-grass oil with some of the more promising antioxidants

The same sample of oil used in the foregoing experiments was employed, and 0 5 c c of the control and protected sample was measured out into 50 c c amber-coloured bottles with tight fitting stoppers sealed with rosin-wax and stored in an incubator at 37°C ± 0 5 At regular intervals, three bottles of each set were taken out, their contents mixed together, and the citral content was estimated as before These estimations were continued until a reduction of about 40 per cent of the original content of citral was noticed in the samples The induction periods were determined from the curves

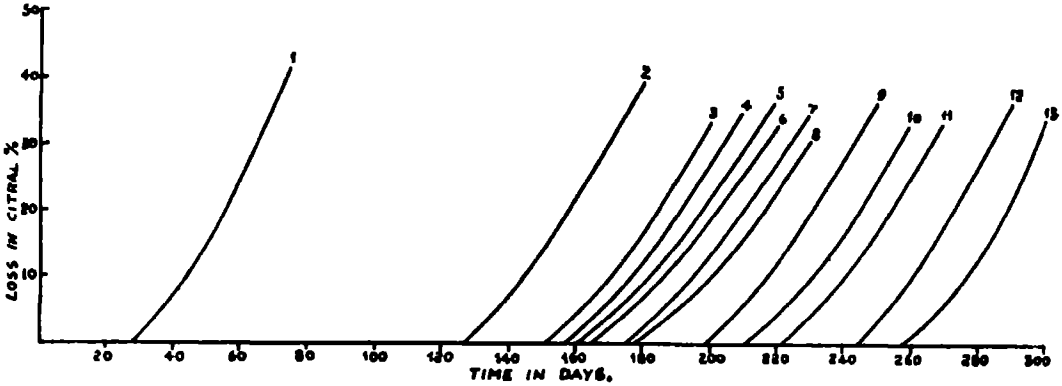

FIG 2 — STABILIZATION OF CITRAL IN LEMON-GRASS OIL BY ANTIOXIDANTS

1 Control, 2 hydroquinone (0 02%), 3 *iso*-butyl gallate (0·02%), 4 *n*-butyl gallate (0·02%), 5 *n*-propyl gallate (0·02%). 6 ethyl gallate (0·02%), 7 pyrogallol (0·02%), 8 hydroquinone (0·02%) + citric acid (0·01%), 9 *iso*-butyl gallate (0·02%) + citric acid (0·01%), 10 *n*-butyl gallate (0·02%) + citric acid (0·1%), 11 *n* propyl gallate (0·02%) + citric acid (0·01%), 12 ethyl gallate (0·02%) + citric acid (0·01%), and 13 pyrogallol (0·02%) + citric acid (0·01%)

drawn with period of storage in days as abscissae and percentage loss in citral as ordinates. The results are summarized in Table V and the curves are shown in Fig 2

Discussion

The results given in Table I show that the citral content and bactericidal potency of lemon-grass oil decrease on storage Crude oils which were dark in colour in comparison with the very light-yellow colour of re-steam distilled samples were comparatively more stable than the purified oils About 60 per cent loss of citral occurred in the purified oils and about 50 per cent in the crude oils on storage for a period of two years The bactericidal potency fell appreciably in all the samples on storage The stored samples also deteriorated in colour and perfume The reason for higher stability of crude oils than of purified oils is not properly understood Probably the resinous and colouring impurities which are present in crude oils may exert antioxygenic action

The results given in Table II show that the total amount of oxygen absorbed in each of the four samples tested was almost the same The period of exposure during which the maximum amount of oxygen was absorbed in the crude oil was, however, appreciably longer than that in the case of the corresponding re-steam distilled oil The induction

TABLE IV — SYNERGETIC EFFECT OF MIXTURES OF ANTIOXIDANTS ON AUTOXIDATION OF LEMON-GRASS OIL

Antioxidants added & concentration, %		Induction period, min	Protection factor
Control		35	
Pyrogallol (0 06)	+ citric acid (0 03)	565	15 14
"	+ tartaric acid (0 03)	560	15 00
"	+ glutamic acid (0 03)	390	10 14
"	+ oxalic acid (0 03)	400	10 42
"	+ malonic acid (0 03)	420	11 00
"	+ succinic acid (0 03)	425	11 14
"	+ ortho-phosphoric acid (0 03)	525	14 00
"	+ cane sugar (0 03)	365	9 42
Ethyl gallate (0 06)	+ citric acid (0 03)	515	13 71
"	+ tartaric acid (0 03)	515	13 71
"	+ ortho-phosphoric acid (0 03)	495	13 14
"	+ succinic acid (0 03)	350	9 00
"	+ malonic acid (0 03)	375	9 71
"	+ cane sugar (0 03)	315	8 00
n-propyl gallate (0 06)	+ citric acid (0 03)	500	13 28
"	+ tartaric acid (0 03)	505	13 42
"	+ ortho-phosphoric acid (0 03)	385	10 00
"	+ malonic acid (0 03)	315	8 00
n-butyl gallate (0 06)	+ citric acid (0 03)	415	10 85
"	+ tartaric acid (0 03)	400	10 42
"	+ ortho-phosphoric acid (0 03)	335	8 57
"	+ succinic acid (0 03)	290	7 28
Iso-butyl gallate (0 06)	+ citric acid (0 03)	365	9 42
"	+ tartaric acid (0 03)	375	9 71
"	+ ortho-phosphoric acid (0 03)	310	7 85
"	+ glutamic acid (0 03)	255	6 28
Hydroquinone (0 06)	+ citric acid (0 03)	335	8 57
"	+ tartaric acid (0 03)	340	8 71
"	+ ortho-phosphoric acid (0 03)	255	6 28
"	+ glutamic acid (0 03)	225	5 42
Cane sugar (0 06)	+ ortho-phosphoric acid (0 03)	110	2 14
"	+ citric acid (0 03)	110	2 14
"	+ glutamic acid (0 03)	75	1 14

TABLE V — STABILIZATION OF CITRAL IN LEMON-GRASS OIL BY ANTIOXIDANTS

Antioxidants added & concentration, %		Induction period*, days	Protection factor
Control		25	
Pyrogallol (0 02)		178	5 92
Ethyl gallate (0 02)		164	5 56
n-propyl gallate (0 02)		160	5 40
n-butyl gallate (0 02)		156	5 24
Iso-butyl gallate (0 02)		150	5 00
Hydroquinone (0 02)		125	4 00
Pyrogallol (0 02)	+ citric acid (0 01)	257	9 28
Ethyl gallate (0 02)	+ citric acid (0 01)	244	8 76
n-propyl gallate (0 02)	+ citric acid (0 01)	221	7 84
n-butyl gallate (0 02)	+ citric acid (0 01)	210	7 40
Iso-butyl gallate (0 02)	+ citric acid (0 01)	198	6 92
Hydroquinone (0 02)	+ citric acid (0 01)	177	6 08

* Induction period in this case refers to the time in days during which there is no deterioration of citral

period of crude oil was also found to be slightly longer than that of the corresponding purified oil The fall in citral content and germicidal potency in lemon-grass oils occurred along with the absorption of oxygen When the absorption of oxygen was complete, the citral content was lowest and the germicidal potency was practically nil The autoxidized oils deteriorated in perfume and colour also

Figs 1 and 2 show that the length of the induction period gives sufficient indication of the comparative efficiency of different antioxidants and, after the end of the induction period, the rate of deterioration of lemon-grass oil is practically of the same order, irrespective of the nature of the antioxidant used Both the accelerated oxygen-absorption tests (TABLES III and IV) and the storage tests (TABLE V) agree well in placing various antioxidants in order of their efficiencies The two sets of data on oxygen absorption and storage of lemon-grass oil have revealed that the antioxidants which can prevent autoxidation of the oil are also capable of stabilizing citral in it

Of all the antioxidants tested singly, the first six antioxidants in the descending order of their efficiency are pyrogallol, ethyl gallate, *n*-propyl gallate, *n*-butyl gallate, *iso*-butyl gallate and hydroquinone The antioxygenic action of acid-type and nitrogenous inhibitors and sugar when used alone in lemon-grass oil is practically negligible

Synergetic action of the antioxidants is exhibited in almost all the combinations tried (TABLES IV and V and FIGS 1 and 2) The maximum inhibiting action is afforded by pyrogallol and citric or tartaric acid Ethyl gallate or *n*-propyl gallate in association with citric or tartaric acid has been found to be equally efficient

Pyrogallol when incorporated in the oil has, however, been observed to impart a dark colour to the oil on storage Again, it may be toxic The gallates do not discolour the oil They have also been reported [5a, 11] to be non-toxic The preparation of the gallates is also easy and inexpensive.

Summary

(1) Lemon-grass oils are susceptible to the loss of citral and their germicidal property during storage The rate of deterioration is comparatively faster in purified oils than in crude oils.

(2) The oils are subject to easy autoxidation The amount of oxygen absorbed in the oil has been quantitatively measured at different stages of autoxidation and it has been demonstrated that the fall in citral content and bactericidal potency is principally due to the autoxidation of the oil

(3) The comparative efficiency of a large number of antioxidants has been determined with reference to lemon-grass oil by measuring the "induction period" of the oil treated with and without antioxidants by the accelerated oxygen-absorption method The synergetic effect of the combinations of suitable antioxidants has also been studied in a similar way

(4) The efficiency of the promising antioxidants, as revealed by the oxygen-absorption tests, has been compared against the stabilization of citral in the oil when stored in thin layers under atmospheric conditions There is good agreement between the relative potencies of the antioxidants as tested by the oxygen-absorption method and by the storage tests

(5) Pyrogallol or ethyl gallate or *n*-propyl gallate, in association with citric or tartaric acid, has been found to afford significant protective action against the autoxidation of the oil The use of pyrogallol, however, has certain disadvantages Hence, ethyl or *n*-propyl gallate in conjunction with citric or tartaric acid appear to be the best antioxidants so far examined.

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Influence of Pumice on the Rate of Alcoholic Fermentation

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The use of pumice impregnated with distillery yeast in packed columns of a continuous fermenter accelerates the rate of fermentation of molasses and increases the efficiency of a given quantity of yeast This is due to the ability of pumice to prevent supersaturation of the medium with carbon dioxide Pumice prevents the coalescence and caking of yeast cells and thus maintains the fermentative efficiency of yeast cells at its peak value A 40 per cent increase in the attenuation value over the control is obtained with impregnated pumice at the end of 60 hr and fermentation during the first 2 hr proceeds almost at twice the rate

IN the course of our experiments on the development of a continuous or a semi-continuous process for the alcoholic fermentation of molasses, it was surmised that pumice impregnated with yeast might provide a catalytically active material suitable for employment in a packed column Such a column may be expected to bring about the fermentation of a solution of molasses during its passage through it Previous attempts at developing continuous processes for alcohol fermentation have not been entirely successful and none of them has so far been developed to an exploitable stage on a factory scale The batch process in which fermentations are carried out in large vats or tanks, still remains in vogue

The Guillaume process (Monier-Williams[1]), which can claim to be continuous, suffers from the disadvantage that the yeast is carried away by the moving mass of fermenting liquid More recently, Owen[2] devised a laboratory-scale assembly for continuous fermentation The apparatus provides for a downward flow of the mash to be fermented through a column equipped with a series of baffles where the yeast gets sedimented This arrangement possesses the disadvantage that the yeast sediment gets caked and, in consequence, it is unable to function at its peak efficiency Bilford *et al*[3] made a preliminary report on a laboratory scale on fast continuous fermentation involving a constant feed and draw off The reaction proceeds in two stages in two fermenters

It was of interest to determine if a porous material like pumice would offer the necessary surface for yeast cells to anchor themselves on, prevent coalescence and caking and thereby offer the maximum possible "zymo-catalytic" surface

Experimental

Pieces of pumice averaging in diameter between 0 1" and 0 25", were refluxed with concentrated hydrochloric acid for 4 hr, the material was thoroughly washed with water to free it from acid, and dried at 400°C This material was employed in all the following experiments

60 gm of the pumice were treated with 100 c c of a suspension of distillery yeast (12 5 gm in 100 c c) *in vacuo* with a view to "impregnate" the porous mass with the suspension The excess of suspension was drained off and its volume measured It was found that about 25 c c of the suspension was taken up by 60 gm of pumice Treated pumice, mixed with a cane sugar medium, fortified with ammonium sulphate and phosphate, brought about comparatively sluggish fermentations, when cane sugar was replaced by molasses, however, the fermentation proceeded vigorously The molasses medium was composed of molasses, 60 gm, ammonium sulphate, 3 gm, potassium dihydrogen phosphate, 3 gm, all dissolved in tap water, *p*H 4 5, and final volume, 100 c c

240 c c of this medium were treated either with 60 gm of the impregnated pumice or an equivalent quantity of the yeast suspension The densities of the two reaction mixtures were equalized by the addition of requisite amounts of water The initial concentration of sugar present in the reaction mixture was estimated by the method of Stiles *et al*[4] The course of fermentation was followed by specific gravity determinations at various intervals of time and the degree of attenuation calculated One degree of attenuation corresponds to 0 1216 per cent by volume of alcohol

The data given in Table I and the graph (FIG 1) show that during the first 2 hr the fermentation with pumice proceeds at almost twice the rate

Similar results have been obtained with molasses (TABLE II and FIG 2)

TABLE I — RATE OF FERMENTATION OF CANE SUGAR BY YEAST WITH & WITHOUT PUMICE

	ATTENUATION IN DEGREES AFTER hr								
	22	46	94	118	142	166	190	286	310
(A) No pumice	9	24	46	56	62	67	74	84	90
(B) Impregnated pumice	28	50	63	89	92	94	96	99	99

TABLE II

	ATTENUATION IN DEGREES AFTER hr								
	18	22	47	66	95	119	144	162	186
(A) No pumice	15	21	46	61	80	88	98	103	106
(B) With pumice	22	22	65	85	100	107	109	109	109
(C) Impregnated pumice	30	41	77	94	107	111	112	112	112

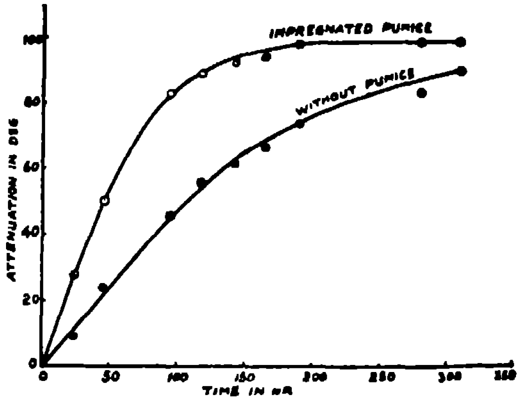

FIG 1

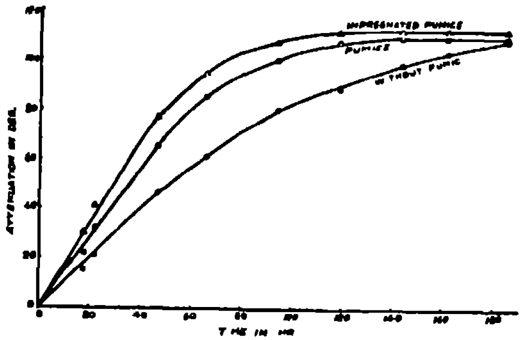

FIG 2

The accelerating effect of pumice is clear, as a 40 per cent increase in attenuation over the control is attained at the end of 60 hr, with impregnated pumice the corresponding increase is 60 per cent

Sharp-edged and rough-surfaced solids like pumice are known to prevent supersaturation of gases in their respective solvents The beneficial effect of pumice is possibly due to the prevention of supersaturation of the medium with carbon dioxide, whose accumulation in high concentration would tend to inhibit the rate of fermentation To test the validity of this hypothesis, another set of experiments was designed where supersaturation was sought to be prevented by two entirely independent methods of keeping the reaction mixture stirred up (1) by an electric stirrer and (2) by bubbling a stream of inert gas such as nitrogen The necessary control experiments (1) reaction without pumice and without stirring and (2) reaction with impregnated pumice were simultaneously carried out

From a close study of the data given in Tables III and IV and Figs 3 and 4, it will be seen that bubbling of nitrogen through the reaction mixture does not appreciably accelerate the rate of fermentation On the contrary, when the bubbling of gas is carried out very vigorously (TABLE IV), there is a definite decrease in the rate of fermentation Mechanical stirring of the reaction mixture appears to accelerate the rate, and this increase is comparable to that attained by the addition of pumice The results support the view that by preventing a condition of supersaturation of the reaction mixture with carbon dioxide, the rate of fermentation can be accelerated These findings are further confirmed by a simultaneous determination of the sugar consumed during the fermentation (TABLE V and FIG 5)

TABLE III

	ATTENUATION IN DEGREES AFTER hr						
	29	53	77	100	124	147	195
No treatment	22	45	59	70	80	87	95
+ Nitrogen	23	48	65	76	86	93	98
+ Pumice	44	71	86	94	99	100	101
+ Impregnated pumice	51	80	93	100	104	104	104

TABLE IV

	ATTENUATION IN DEGREES AFTER hr						
	18	42	66	95	114	162	184
No treatment	16	51	75	90	95	105	107
+ Nitrogen*	12	45	70	86	92	104	106
+ Mechanical stirring	23	71	100	106	107	107	107
+ Impregnated pumice	28	85	104	107	107	107	107

*Nitrogen was bubbled through at a much faster rate than that in the previous experiment (*see* TABLE III)

TABLE V

	SUGAR CONSUMED IN GM PER 100 C C. OF FERMENTING MEDIUM hr			
	18	42	66	95
No treatment	3 29	11 05	15 85	18 91
+ Nitrogen	2 65	9 79	14 51	18 07
+ Mechanical stirring	4 97	15 72	20 35	21 77
+ Impregnated pumice	7 17	18 30	21 19	21 96

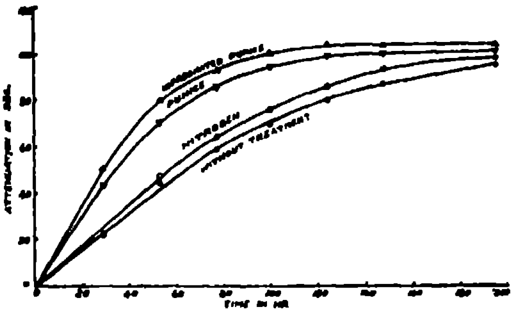

FIG 3

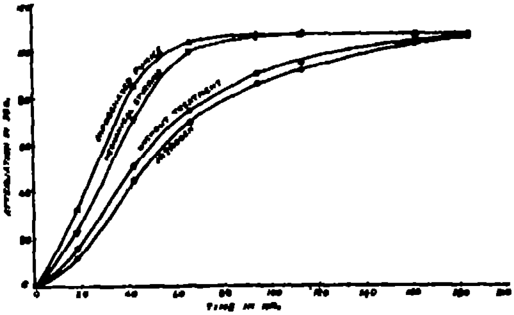

FIG 4

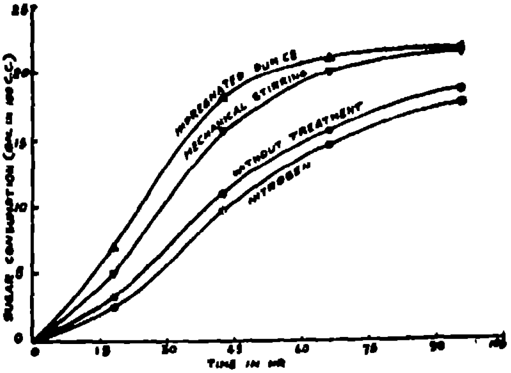

FIG 5

Fermentative reactions carried out with impregnated pumice, however, proceed at rates which are distinctly higher than any other figure In some cases it will be seen that the maximum attenuation is reached within 80-90 hr This is due to the additional effect of "impregnation" of pumice with yeast cells which, during the process of impregnation, get distributed over the large surface of pumice and are maintained there as such to a large extent The catalytic efficiency of a given quantity of yeast is thereby increased and sustained

Summary & Conclusion

1 Addition of pumice accelerates the rate of fermentation of molasses by distillery yeast, this is due to the ability of pumice

to prevent supersaturation of the medium with carbon dioxide

2 Pumice offers a suitable anchorage for the lodgement of yeast cells, pumice " impregnated " with yeast cells brings about a further acceleration in the rate of fermentation

3 Pumice prevents to a large extent the coalescence and caking of yeast cells and thereby helps to maintain their fermentative efficiency at its peak value

4 Impregnated pumice shows promise as a catalyst for packed columns in which continuous fermentations of molasses can be carried out Further work in this direction is in progress

Our grateful thanks are due to the *Council of Scientific & Industrial Research* for financing the research project of which the present investigation forms a part Our grateful thanks are also due to Sir J C Ghosh and Mr E V Ganapathi Iyer for their kind interest and encouragement

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Purification of Commercial Stearic Acid

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Fractional crystallization of commercial stearic acid from acetone and methyl alcohol, acetone and rectified spirit and benzene and methyl alcohol binary mixtures have been attempted Three crystallizations from a mixture of acetone and methyl alcohol (4 . 1) gives the best result A product of 96 per cent purity, melting at 68·9°C., is obtained with an overall recovery of 20 per cent pure stearic acid.

THE triple-pressed stearic acid of commerce contains only 45 per cent stearic acid, nearly all the rest being palmitic acid A sample of the acid tested in our laboratories was yellowish, waxy, with a m p, 53 5°-54°C The determination of acid value showed the presence of as much as 55 per cent palmitic acid, and the iodine number indicated 2 per cent oleic acid. The nitrile prepared from the sample was a liquid with a freezing point of 17°-18°C (m p of pure stearonitrile, 41°C) and had a nitrogen content (Kjeldahl) of 5 63-5 65 per cent, while pure stearonitrile has 5·28 per cent nitrogen and palmitonitrile 5 95 per cent nitrogen which is an additional proof of the presence of palmitic acid

The commercial method of purification of fatty acids is by vacuum fractional distillation with the aid of steam[1] in a Wecker still[2] or in a bubble cap column[3] These methods require high vacuum equipment and special materials of construction to withstand the corrosion by fatty acids at high temperatures (molybdenum-stabilized stainless steel should be used as 18-8 stainless steel is not resistant enough) Due to the high initial and maintenance costs of this method, a simpler method like the solvent crystallization process has been a long-felt need in industry The recent Emersol process[4] of stearic acid separation is convenient and flexible to yield stearic acid of the required grades of purity Adelson's patent[5] (*Shell Development Co*) relates to the purification of 85 per cent commercial acid by repeated crystallization from C_4 to C_9 ketones and a purity of 96-99 per cent for the products is claimed

The purification of mixed fatty acids has been carried out on a laboratory scale by (a) separation of the saturated acids from unsaturated acids and (b) isolation of individual fatty acids by fractional distillation of esters For (a) the method generally adopted is fractional crystallization of lead soaps from alcohol, ether or benzene[6-8] Metallic soaps of Ba, Mg and Li have also been tried[9] Other methods reported are (i) saponification of solid and liquid fats with equivalent amounts of mixed alkalies like sodium hydroxide and calcium hydroxide, separation of insoluble soaps and regeneration of acids[10], (ii) fractional solidification of mixed fatty acid emulsions[11] and (iii) chromatographic separation[12] It has been recently suggested[13] that separation of saturated and unsaturated acids can be effected through solvent crystallization at —30° to —60°C This method has been sufficiently developed[14-21] to replace the lead soap method and particularly so in the case of polyethynoid acids[6a] It is also possible now to prepare by the same method individual unsaturated acids in a high grade of purity[22,23]

The simplicity and ease of the fractional crystallization method recommends itself for the purification and isolation of individual saturated acids but there is a conspicuous dearth of literature regarding the same Guy and Smith[24] obtained pure samples of palmitic and stearic acids by repeated crystallization of commercial samples, involving more than 20 crystallizations and half a dozen fractional distillations Data regarding the quality and quantity of the solvent used, temperature and other conditions of crystallization, method of drying, etc, are not available The yield of stearic acid was poor and the melting point of the final sample (69 62°C) was still 0 28°C lower than that of the pure product[24]

The present work is an attempt to purify commercial stearic acid by fractional crystallization employing binary mixtures of acetone-methyl alcohol, and acetone-rectified spirit in varying proportions Oleic acid which is found to be present to an extent of 2 per cent in the commercial sample gets eliminated even during the first crystallization since the solubility of oleic acid is very much greater than that of saturated acids in any of the above solvents at 20°C The problem is, therefore, one of elimination of palmitic acid Though the solubilities of these two acids at 20°C in the above organic solvents are low, slightly larger amounts were held in solution during the first crystallization, probably due to " mutual solubility effect " reported by Foreman and Brown[6a] The ratio of the solubilities of stearic and palmitic acids in different solvents are

TABLE I — YIELD & PERCENTAGE PURITY OF STEARIC ACID USING ACETONE-METHYL ALCOHOL MIXTURES

Acetone (B D H) sp gr, 0 7950, methyl alcohol 96 97% pure, sp gr, 0 7925

ACETONE METHYL ALCOHOL RATIO	FIRST CRYSTALLIZATION			SECOND CRYSTALLIZATION			THIRD CRYSTALLIZATION		
	Stearic acid, % purity (a)	m.p., °C (b)	Dry yield, gm.	Stearic acid, % purity	m.p., °C.	Dry yield, gm	Stearic acid, % purity	m.p., C.	Dry yield, gm.
100 0	54 19	57 6	11 12	75 26	64 6	8	87 18	68 4	5
80 20	58 77	60	13 14	79 82	65 9	7	94 5	68 9	4 5 5 0
50 50	55 11	55 2	20	72 57	64 4	11	92 57	68 6	5
20 80	60 6	54	21	81 68	61 6	12	95 42	67 4	6
0 100	63 36	55	21 22	64 27	60 8	13	90 84	66 6	9

(a) The percentage of stearic acid was determined by the estimation of acid value of the sample and calculating on the assumption that only palmitic acid was present in association with stearic acid. The limit of accuracy of this method is 4 0 4 5 per cent

(b) In most cases the material softens 0 2°C lower than the melting point

TABLE II — YIELD & PERCENTAGE PURITY OF STEARIC ACID USING ACETONE-RECTIFIED SPIRIT MIXTURES

Acetone (B D H) sp gr, 0 7950, rectified spirit, 91%, sp gr, 0 8300

ACETONE RECTIFIED SPIRIT RATIO	FIRST CRYSTALLIZATION		SECOND CRYSTALLIZATION		THIRD CRYSTALLIZATION		
	Stearic acid, % purity	m.p., °C.	Stearic acid, % purity	m.p., °C.	Stearic acid, % purity	m p., °C	Dry yield gm.
80 20	56 95	58 0	67 94	65 8	95 52	68 6	4 0 4 5
50 50	52 37	55 6	74 4	64 0	96 34	68 4	5 0
20 80	47 78	56 8	80 67	64 2	94 51	68 2	6 0
0 : 100	68 85	56 6	81 68	62 0	91 71	66 6	5 0

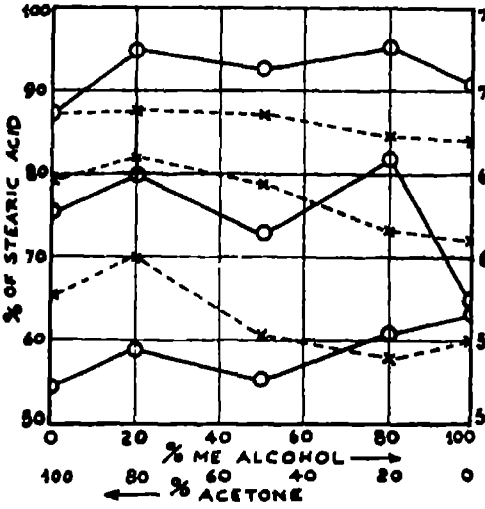

FIG. 1

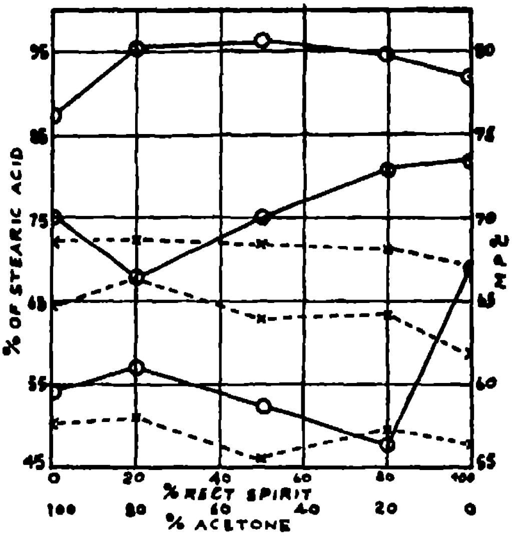

FIG 2

acetone, 1 3 5 (20°C), methyl alcohol, 1 5 (10°C), and ethyl alcohol, 1 3 2 Low temperatures of the order of −30°C and −60°C are not necessary because these C_{16} and C_{18} saturated acids are solids at room temperature, and their solubilities are sufficiently low For a compromise between yield and purity, we have chosen 20°C for crystallization, which is also the temperature adopted by Adelson[6]

Experimental

25 gm of commercial acid were dissolved in 125 c c of the solvent at 35°-40°C The solutions were chilled to 20°C maintaining mechanical agitation and centrifuged for 5-6 min at 1,600 r p m 50 c c of the same solvent at 20°C was used to wash the cake (no precaution was taken to keep the centrifuge basket at 20°C) The first crop of crystals was redissolved (without drying) in 125 c c of solvent and the process repeated The crystals were subjected to a third crystallization using 100 c c of the solvent for dissolving and 40 c c for washing The final crop of crystals was gently heated and melted in an atmosphere of carbon dioxide to drive off excess solvent

The results obtained employing acetone-methyl alcohol and acetone-rectified spirit mixtures are given in Tables I and II respectively The values are expressed graphically in Figs 1 and 2

An attempt was made to purify stearic acid by crystallization from a mixture of a non-polar solvent like benzene with a polar solvent like methyl alcohol Technical benzene and methyl alcohol (96 per cent purity) were employed In the case of benzene (at 20°C), very little crystallization took place, the whole mass frothing under mechanical agitation A lower temperature (15°-25°C) was employed and maintained for 5-10 min The experimental procedure was

TABLE III — YIELD & PERCENTAGE PURITY OF STEARIC ACID USING BENZENE-METHYL ALCOHOL MIXTURES

Benzene (tech), methyl alcohol, 96-97% pure

BENZENE METHYL ALCOHOL RATIO	FIRST CRYSTALLIZATION		SECOND CRYSTALLIZATION		
	Stearic acid, % purity	m.p., °C.	Stearic acid, % purity	m p., °C.	dry yield (approximate), gm.
100 0	52 87	56 8	62 4	64 6	2
80 20	65 27	57 8	79 55	64 4	0 8
50 50	86 11	60 6	89 8	65 2	2 6
20 80	58 28	54 2	58 78	55 2	12

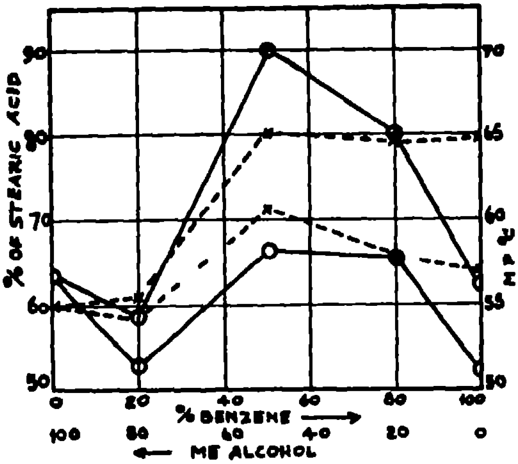

Fig 3

the same as described earlier except that no washing was done in a centrifuge and that in the second crystallization 50 c c of the solvent was used to dissolve the crystals The results are given in Table III and graphically represented in Fig 3

As the yield and the melting points of the samples from benzene alcohol mixtures were not satisfactory further purification was abandoned

Summary

A solvent mixture of 80 per cent acetone and 20 per cent methyl alcohol is found to be the best combination for the purification of commercial stearic acid by fractional crystallization In three crystallizations 95 96 per cent pure stearic acid is obtained The overall recovery is 20 per cent i e 45 per cent of the total stearic acid originally present in the commercial sample Thus by foregoing about half of the required substance it is possible to recover stearic acid in a fairly high degree of purity with comparative ease and simplicity and without recourse to any special equipment These advantages themselves are sufficient to recommend the process for the purification of stearic acid on a small scale

My thanks are due to Dr M A Govinda Rao the Director of Technology for his kind interest in this work

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A Pilot Plant for the Production of Pure Nitrogen & Nitrogen-Hydrogen Mixtures

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A pilot plant for the production of "synthesis gas", its set up and operation have been described. The special feature of the plant is its adaptability to produce nitrogen hydrogen mixture in any desired proportion or pure nitrogen alone The principle of surface combustion adopted has enabled this object to be achieved as also to eliminate chances of explosion. Final gas with a purity of 99 99 per cent in respect of oxygen is produced at a rate of 500 litres per hour.

DURING investigation on synthetic ammonia catalysts taken up under the "Industrial Catalysis" scheme sanctioned by the Board of Scientific & Industrial Research, considerable difficulty was experienced in obtaining nitrogen-hydrogen mixture A ready and uninterrupted supply of "synthesis gas" was of primary importance and a pilot plant was developed on lines almost similar to the one in the *Mysore Chemicals & Fertilisers Limited* The special feature of the plant is its adaptability to produce nitrogen-hydrogen mixture in any desired proportion or pure nitrogen alone by a process of burning hydrogen in air, with virtually complete elimination of oxygen To achieve this object and to eliminate chances of explosion, the principle of surface combustion has been adopted Hydrogen is made to burn, without forming a flame, on an incandescent bed of refractory material packed in the combustion chamber[1]

The set up and design of the plant are shown in Figs 1 and 2, and it is expected that it would serve as a model for applied research laboratories where, besides "synthesis gas", nitrogen of a high degree of purity is in demand The plant has been assembled out of readily available materials and very little expenditure has been incurred in setting it up

The operation of the plant is briefly described as follows

The heating circuit in the combustion chamber is switched on half an hour before the commencement of the burning operation After filling the gas holder completely with water, the inlet and outlet cocks for gas and water are closed When the refractory bed has attained a glowing temperature (as visible through the peep-hole), hydrogen and air are slowly admitted almost simultaneously into the chamber Provision has been made for connecting the chamber to a suction arrangement operated by a water-jet aspirator and, if necessary, the system may be partially evacuated to avoid explosion The temperature of the bed goes up rapidly on account of progressive burning of hydrogen when the heating unit is switched off Thereafter, the temperature of the bed is maintained almost steady by the heat of combustion By careful manipulation of gas and water cocks of the gas holder, a part of the products of combustion is led through the sample cock on the catch pot and analysed for oxygen Usually after about 3-5 minutes' burning, no oxygen is detectable by Hempel's method of gas analysis, when the gas holder is finally connected for the collection of gas By careful operation of the water exit cock, a positive pressure of 2"-3" w g is maintained in the system A little care is needed in the beginning to adjust the rate of flow of water with the rate of burning, but once a steady pressure condition has been built up, no further attention is necessary, except occasionally to the needle valves for maintaining the desired flow rates of hydrogen and air While shutting down, the chamber is first of all connected to suction and then the supply of air and hydrogen stopped

When compressed gas of a high degree of purity is required, it is drawn by displacement with water Gas is fed to the compressor through the purification train under

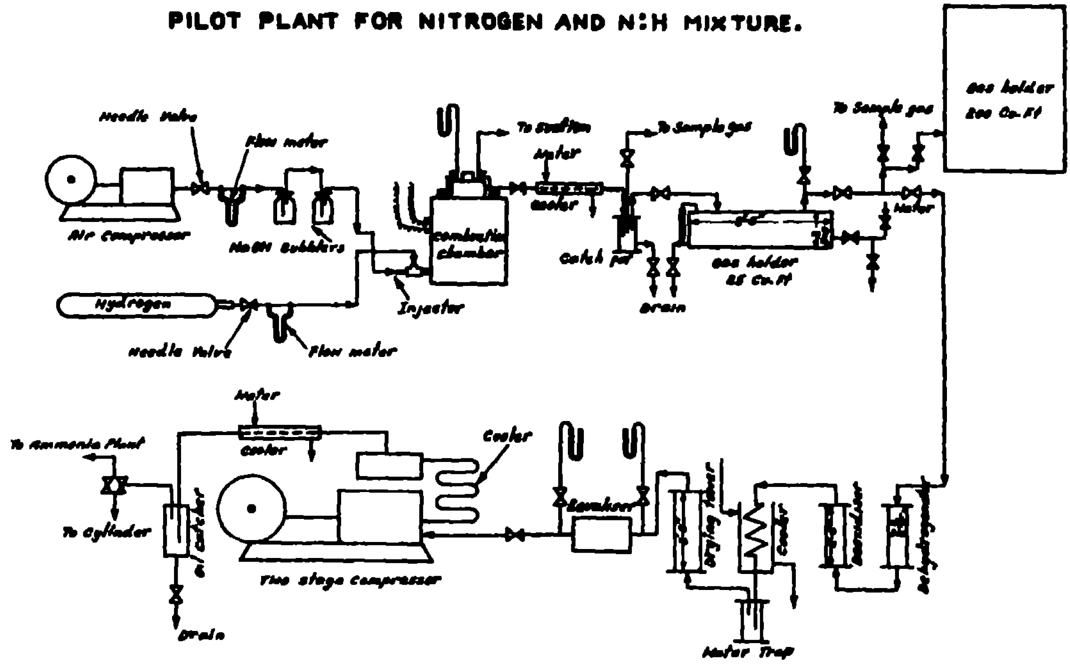

FIG 1

a pressure of 2"-3" of mercury as indicated by the manometers on the equalizing tank Removal of last traces of hydrogen and oxygen is effected by the dehydrogenator and deoxidizer respectively both of which are maintained at about 600°C When pure nitrogen is needed, both the units are worked but when ' synthesis gas ' or any other N-H mixture is the desired product the deoxidizer unit only is worked Reactivation of the beds contained in the dehydrogenator and deoxidizer is done respectively by passing air and hydrogen through the hot bed after disconnecting them from the system Since only traces of hydrogen and oxygen have to be removed the reactivation is necessary only at long intervals

Ordinarily, by Hempel s method, no oxygen is detectable in the products collecting in the gas holder Since the sensitivity of the method is never below 0 2 per cent it has been necessary to test for oxygen by some other accurate method The modified Winkler s method described by Winslow and Liebhafsky[8], which consists in precipitating manganous hydroxide in oxygen-free water in an evacuated apparatus and shaking the precipitate in the atmosphere to be tested for oxygen, has been found suitable The oxidized manganous hydroxide on acidification liberates equivalent amount of iodine which is then titrated against standard sodium thiosulphate This method has enabled us to determine very low oxygen concentrations of the order of 0 01 per cent

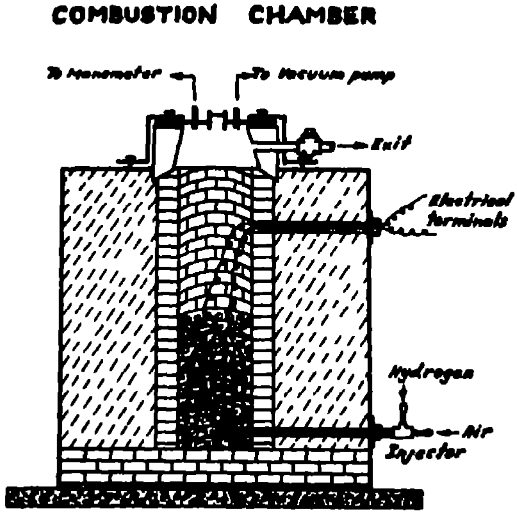

FIG 2

When testing the purity of nitrogen gas besides oxygen unburnt hydrogen is estimated by passing a known volume of dry gas over copper oxide at 600°C Moisture resulting from combustion of hydrogen is absorbed in anhydrone

Usually the gas collecting in the gas holder at the maximum possible rate of 500 litres of final gas per hour shows a purity of 99 85 per cent in respect of oxygen By passing it through the purification system compressed gas at a pressure of about 2 000 lb /sq in with a purity of 99 99 per cent has been obtained

The authors wish to express grateful thanks to Dr J C Ghosh under whose instruction the investigation was taken up Thanks are also due to Professors B Sanjiva Rao and S K Nandi for their keen interest Further the assistance rendered by Mr S Vedaraman in the preliminary stages of the investigation is thankfully acknowledged

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Letters to the Editor

GERMANIUM IN SPHALERITE FROM NEPAL

IN VIEW OF THE RECENT USE OF GERMANIUM crystal as a rectifier for ultra short radio waves it is worth while to make a thorough investigation of the possible sources of germanium in India Recently one of us made a search for germanium in coal ashes from different coalfields in India and a fair concentration of germanium was detected in a few samples[1,2]

Argyrodite canfieldite and germanite are the only ores rich in germanium known at present But none of them have been reported to occur in India Zinc blende from different countries has been investigated by different workers[3] and in majority of samples germanium has been detected in traces

Specimens of sphalerite collected from Nepal by one us have been spectroscopically examined Two of these samples have been found to contain germanium (FIGS 1 4) The following metals have also been detected in the mineral Sn Pb Mg Al Si Ga Cd Ge Ag and Fe

During our investigation we found that germanium occurs concentrated in the magnetic portion of the mineral which seems to be almost pure iron oxide with traces of sulphur lead zinc gallium and germanium The non magnetic portions were also examined spectroscopically and found to contain germanium only in traces

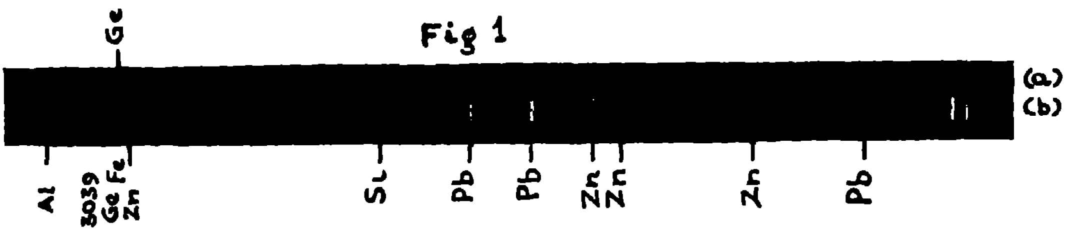
Germanium was estimated colorimetrically according to the method by Marcel Orliac[4] slightly modified by us

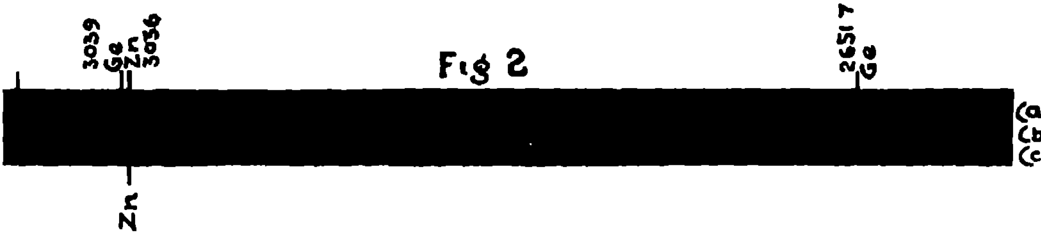
The percentage of germanium in the magnetic portion has been found to be about 0 24 while it varies in the non magnetic portion from 0 0072 to 0 04 300 mg of pure GeO_2 has been extracted from 160 gm of the magnetic portion of the mineral

The most abundant source of germanium at present in U S A is the concentrate from residues obtained during the melting of zinc ores Buchanan reports as much as 0 25 per cent of GeO_2 from these residues As the magnetic fraction from sphalerite contains about 0 24 per cent of germanium it can be regarded as a good source of germanium

It appears that germanium has not been detected in any iron ore so far thus this new mineral needs further study We have spectroscopically examined a few haematite and pyrites samples but none of them contains germanium

We take this opportunity to thank the Nepal Government and the Director of the Nepal Bureau of Mines for the samples of sphalerite Our grateful thanks are due





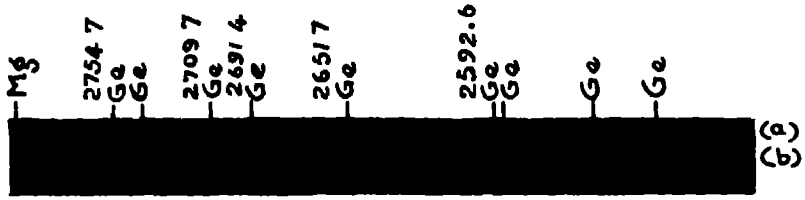


Fig 3

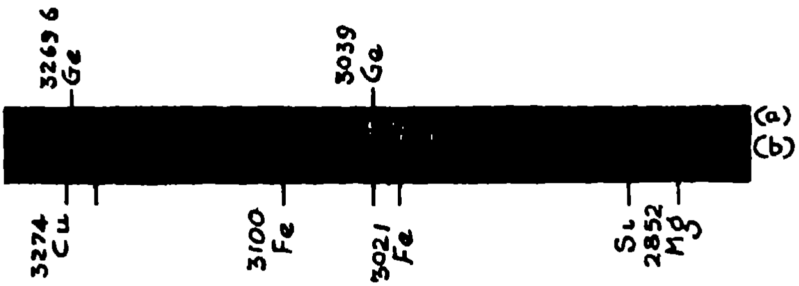


Fig 4

FIG 1 — (a) FE (b) SPHALERITE FIG 2 — (a) FE (b) MAGNETIC SAMPLE (c) NON MAGNETIC SAMPLE FIG 3 — (a) FE (b) GE WITH TRACE OF FE FIG 4 — (a) FE (b) GE WITH TRACE OF FE

to Prof P B Sarkar for his keen interest during the progress of the work One of us (R K D) is indebted to the *Council of Scientific & Industrial Research* for a research grant

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October 27, 1949

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PRESENCE OF A GROWTH FACTOR IN THE ACID HYDROLYSATE OF PAPAIN PREPARATIONS

IT HAS BEEN REPORTED IN AN EARLIER COMmunication that the papain preparation used

TABLE I

INCUBATION PERIOD hr	BLANK c c	SUPPLEMENTS IN C C						CYSTINE + METHIONINE 3 mg each
		Acid hydrolysate		Alkali hydrolysate				
		Titration values in c c of N/20 alkali						
		0 10	0 20	0 10	0 20	0 40	0 60	
24	3 75	4 95	5 25	3 9	4 75	3 65	3 5	4 00
48	5 10	6 15	6 52	5 25	5 40	4 20	3 7	5 25
72	5 25	6 90	7 00	5 40	5 60	4 50	4 0	5 75

in our studies contained tryptophane in a bound and unavailable form Further studies led us to suspect the presence in it of a new growth factor This surmise was tested by using *L arabinosus* N C T C 2161 as test organism

Alkali and acid hydrolysates of the papain preparation were obtained by methods described earlier[1] The total solid contents of the hydrolysates were equalized (15 2mg /c c) and used in graded doses as supplements to the full complement assay medium (TABLE I) To another aliquot of the medium a double concentration (3 mg each) of cystine and methionine were added The final volume of the medium was made up to 3 c c and each tube was inoculated with *L arabinosus* and incubated at 37°C All experiments were carried out in triplicates and the rate of acid production determined at the end of every 24 hr The results obtained are given in Table I

The results show

(1) That the acid hydrolysate of papain contains a growth factor which at 0 1 c c level increases the production of acid in the full complement medium by 25 to 30 per cent

(2) The alkali hydrolysate even at 0 4 and 0 6 c c level is ineffective the growth factor is apparently destroyed by alkali

(3) The addition of cystine and methionine to the complete medium in double concentration does not increase acid production to any significant degree showing thereby that the growth factor is not related to either cystine or methionine

Our grateful acknowledgements are due to the *Council of Scientific & Industrial Research* for financial assistance

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September 11 1949

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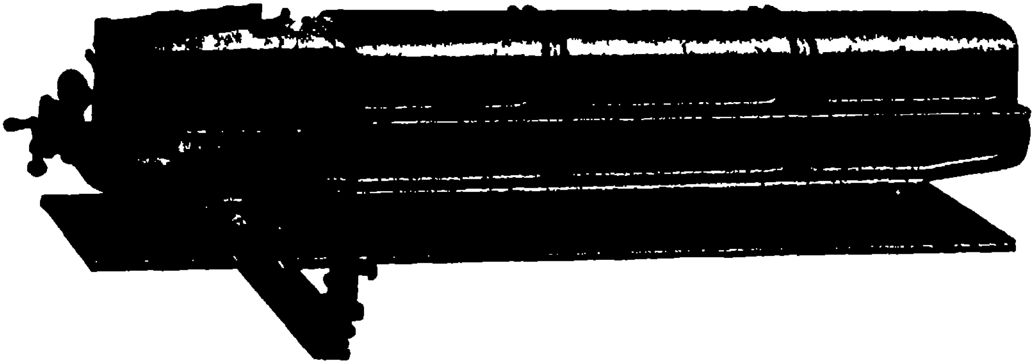

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The Electrolytic Reduction of *Ortho-* & *Meta*-Nitro-benzoic Acids in Acid Medium

---

B B DEY, R KRISHNA MALLER & B R PAI
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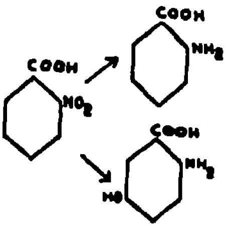
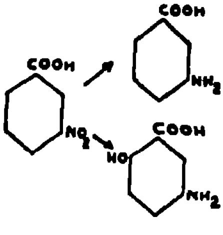
Both *o*- and *m* nitro-benzoic acids have been electrolytically reduced in comparatively dilute acid media (30 per cent sulphuric acid) using copper as cathode and lead as anode Satisfactory methods have been worked out for separating the resulting products in a fair degree of purity

WHEN *ortho*- or *meta*-nitro-benzoic acid is subjected to cathodic reduction in acid media, there is a possibility of at least two products resulting from the experiment, viz the amino-benzoic acids and the corresponding hydroxy-amino-benzoic acids with the phenolic groups in the *para*-position to the amine, the relative proportions of the amine and the amino-phenol depending upon the conditions of experiment

In the case of *ortho*-nitro-benzoic acid, the reduction is expected to lead to the formation of anthranilic and 5-hydroxy anthranilic acids (COOH = 1) in the catholyte, while the *meta*-isomer should yield *m*-aminobenzoic and 5-amino-salicylic acids thus





A survey of literature on the subject provided us with only one reference to the formation of these hydroxy-amino acids during electrolysis This was in connection with the work of Gattermann[1], who had obtained them by the reduction of *ortho*- and *meta*-nitro-benzoic acids at a smooth platinum cathode kept in strong sulphuric acid Gattermann's mode of isolation of the products of reduction consisted mainly in cooling the catholyte and obtaining the sulphates and releasing therefrom the bases by neutralization No details regarding yields or the presence of other acid constituents in the catholyte have been mentioned and although one of the hydroxy-amino acids, viz 5-hydroxy-anthranilic acid, has been characterized fairly fully and correctly, the other, amino-salicylic acid has not been described at all

Both *ortho*- and *meta*-nitro-benzoic acids have now been reduced in comparatively dilute acid media (30 per cent sulphuric), using copper as cathode and lead as anode, and methods of separating and isolating the resulting products in a fair degree of purity have been worked out, although the yields cannot be considered quite satisfactory. While a detailed study of the reduction under different conditions is being made in order to improve the present low yields of the amino-benzoic and hydroxy-amino-benzoic acids, it is of interest to report the preliminary results of the investigation with special reference to the excellent practical method that has been adopted in the separation of the resulting products

Experimental

The nitro benzoic acids required for the purpose were prepared in satisfactory yields by the oxidation of the corresponding nitro toluenes using alkaline permanganate

Electrolytic Reduction of the Nitro benzoic Acids — 20 gm of the nitro benzoic acid in 400 c c of 30 per cent sulphuric acid containing 1 gm of copper sulphate crystals (*A R*) as catalysts were reduced at 80°C by passing a current of 5 amp /hr for 3 hr 51 min (half more time than that required by theory) using copper as cathode material and lead as anode The anolyte (50 c c of 30 per cent sulphuric acid) was not required to be changed during the reduction and the voltage was observed to remain below 4 volts throughout In the case of *o* nitro benzoic acid at the end of the reduction the catholyte was observed to have become dark red in colour while with that of *m* nitro benzoic acid it was almost colourless No unreduced nitro benzoic acid could be isolated from the catholyte in either case

Working up of the Catholytes for Reduction Products (a) *Isolation of Sulphates* — The deeply coloured catholyte obtained after reduction of *o* nitro benzoic acid freed from copper powder by filtration is concentrated *in vacuo* in a stream of hydrogen to half the bulk and then kept in a frigidaire over night when the sulphates of the amino and the hydroxy amino benzoic acids are almost completely precipitated out (*c* 25 gm) From the catholyte of the reduction of *m* nitro benzoic acid however the major portion of the sulphates is precipitated out by keeping the filtered catholyte in the frigidaire without any preliminary concentration (*c* 18 0 gm) By concentration of the filtrate a further amount of the sulphate (7 8 gm) could be obtained The sulphates filtered pressed and dried in a sulphuric acid desiccator are crisp crystalline and pale to dark grey in colour

(b) *Isolation of the Free Acids* — The sulphates are dissolved in 200 300 c c of boiling water and neutralized to alkalinity using a saturated solution of sodium carbonate in water A few drops of dilute sulphuric acid are then added till the solution turns faintly acid It is then treated while hot with 30 gm of copper sulphate crystals dissolved in 100 c c of boiling water and allowed to cool to room temperature and later kept in a frigidaire for complete precipitation of the copper salts

The mixture of the copper salts of amino and hydroxy amino benzoic acids is filtered out washed several times with cold water to free it from inorganic salts and then made into a thin slurry with water and decomposed while hot with hydrogen sulphide The cupric sulphide is then filtered off and the aqueous filtrate freed from excess of hydrogen sulphide by boiling and then evaporated to dryness over a water bath when greyish brown crystals mixed with a dark brown amorphous mass result

On treating the mother liquor from the sulphates in a similar manner with copper sulphate after neutralization to faint acidity no appreciable amount of the copper salts could be obtained

(c) *Separation of the Mixed Acids* (i) *Mixture of Anthranilic & 5 Hydroxy anthranilic Acids* — The mixed acids (10 gm) are separated by employment of benzene in which the hydroxy anthranilic acid was almost insoluble even when hot Therefore the mixture was soxhleted for 4 hr with hot benzene and the benzene extract on standing at room temperature for some time threw down almost all of the dissolved anthranilic acid (yield 8 gm m p 144°C) The benzene insoluble portion was removed and weighed 2 0 gm and melted at 248°C with decomposition 5 hydroxy anthranilic acid according to literature darkens on heating at 235°C and melts with decomposition at 252°C[8] but the electrolytic product of Gattermann (loc cit) however is reported to darken even at 205°C and melt at 230°C with decomposition

(ii) *Mixture of Meta amino benzoic & 5 amino salicylic Acids* — The separation of the two acids from the mixture weighing 10 gm was effected through ethyl alcohol For this purpose the mixture is boiled twice with 93 per cent alcohol (50 c c each time) allowed to cool and then filtered from the insoluble 5 amino salicylic acid From the alcoholic extract *m* amino benzoic acid is recovered by removing the solvent Yield 6 2 gm m p 173° 74°C

The amino salicylic acid (crude 3 7 gm m p 278°C decomp) when crystallized from water containing a little of sodium bisulphite comes out as grey needles (m p 280°C decomp) According to Grandmougin[8] 5 amino salicylic acid obtained synthe tically turns brown at 250°-60°C and decomposes at 280°C., while Meldola *et al*[4] claim a synthetic product melting at 283°C The product obtained reduces ammoniacal silver nitrate and colours ferric chloride deep red On standing, the latter deposits a brown precipitate

Our thanks are due to the *Council of Scientific & Industrial Research* (*India*) for a grant which defrayed the expense of this investigation

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Synthesis of 8-Amino Quinolines: Part I – 8-Biguanide Derivatives

U P BASU, A R SEN GUPTA & A N BOSE
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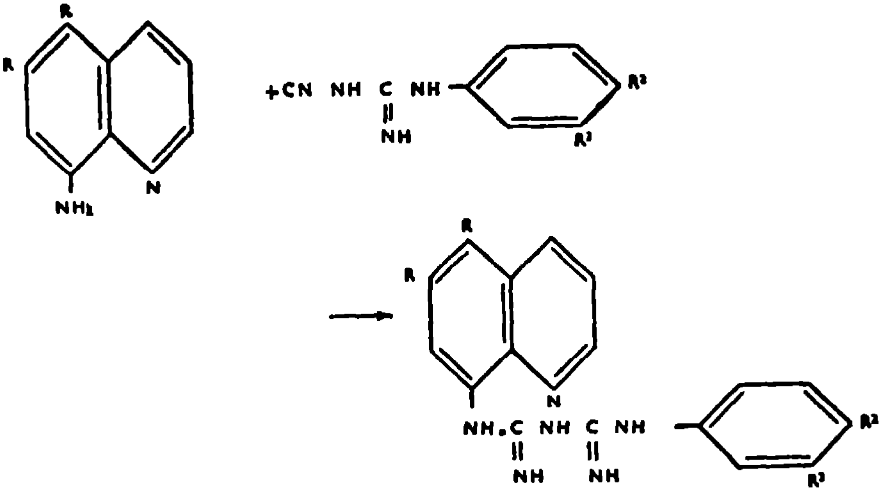
Eight synthetic 8-amino-quinoline-biguanide derivatives have been prepared and tested for gameticidal activity against *Haemoproteus columbae* infection in native pigeons Among them N^1-(6-methoxy-8-amino quinolyl)-N^5-*p*-methoxyphenylbiguanide exerts a definite gameticidal activity

IN a country where thousands of people suffer from malaria, a search for a suitable and easily available prophylactic anti-malarial is of considerable importance Of course, hundreds of compounds comprising numerous structurally different chemical groups have already been studied in different laboratories, but it is surprising to note that it is only in the 8-amino quinolines one finds a unique gameticidal action on all the three species of plasmodium that infect man None of these quinoline derivatives cure vivax malaria alone but only when administered concurrently with quinine No substitute for quinine has in this respect as yet been found, and no explanation for the synergetic effect has yet been clearly put forward Schonohofer's hypothesis[1] of the formation of quinoimine, the difference in the activity of sulfadiazine and quinine or mepacrine in presence of p-amino benzoic acid[2], or the possible inhibition of adenine complex by the biguanide anti-malarial tend to offer some clues to the mode of action of an effective anti-malarial, but none of the various hypotheses proposed warrant postulation at the present stage

The nature of the structure of a particular compound may, however, help in prototropic change in the molecule and this may ultimately enhance the anti-malarial activity of the compound[3-5] On this hypothesis, attempts are being made to introduce some groupings into the quinoline nucleus of the 8-amino quinoline series that may promote a prototropic change and/or tend to form a chelate ring with some metallic ion, trace of which might be often necessary for the metabolism of the malarial parasites[6,7] In view of this fact, certain biguanide derivatives of the type (1) have been synthesized by the action of 8-amino quinoline derivatives on appropriate phenyl dicyandiamide, and are described in this paper The preliminary studies on their gameticidal activity against the *Haemoproteus columbae* infections of native pigeons have also been carried out Results indicate that some of these compounds need more thorough investigation



(I)

where R = H or Cl R^1 OCH_3 R^2 = H OCH_3 or Cl R^3 = H or Cl

Experimental

Preparation of Substituted Phenyl Dicyandiamide — These compounds were prepared according to the method of Curd and Rose[8] The denitrogenation of the intermediate triazine was carried out in presence of acetone and concentrated hydrochloric acid

5 *chloro 6-methoxy 8 amino quinoline* was prepared according to the method of Drake and Anspon[9] the 6-methoxy 8 amino quinoline used was freshly distilled at 168° 72°C under 5 mm pressure

Preparation of N^1 *(6 methoxy 8 amino quinolyl) N*^{5} *p methoxyphenylbiguanide (I)*— A mixture of 6-methoxy 8 amino quinoline hydrochloride (10 5 gm) and p methoxy phenyl dicyandiamide (9 5 gm) prepared according to the method of Curd and Rose[8] in absolute alcohol (60 c c) was heated under reflux for 24 hr[10] The clear solution was cooled diluted with water and then basified with dilute caustic soda solution when a crystalline colourless solid was precipitated It was purified by solution in dilute hydrochloric acid and precipitation by dilute alkali and finally crystallized from alcohol as a colourless crystalline solid (rectangular plates) m p 186° 87°C yield 4 gm (found N 22 8 $C_{18}H_{20}O_2N_6$ requires N 23 07 per cent)

Preparation of N^1 *(6-methoxy 8 amino quinolyl) N*^{5} *p chlorophenylbiguanide (II)*— The method of preparation was the same as described above The alcoholic solution of the reactants was heated under reflux for 24 hr and the solid deposited during refluxing was filtered suspended in water and treated with excess of dilute caustic soda solution After thorough trituration the solid was filtered washed with water and crystallized twice from alcohol in colourless rectangular plates m p 220°C (yield 30 per cent of theory found N 22 51 $C_{18}H_{17}ON_6Cl$ requires N 22 8 per cent)

Preparation of N^1 *(6-methoxy 8 amino Quinolyl) N*^{5} *m chlorophenyl biguanide (III)*— The method of preparation was the same as described above The alcoholic solution of the reactants was heated under reflux for 15 hr and during this period a solid (m p 229° 30°C after crystallization from alcohol) was deposited It was suspended in water and thoroughly triturated with dilute caustic soda The base thus obtained was crystallized from alcohol in colourless rectangular plates m p 163° 64°C yield 35 per cent of theory (found N 22 64 $C_{18}H_{17}ON_6Cl$ required N 22 8 per cent)

Preparation of N^1 *(6 methoxy 8 amino quinolyl) N*^{5} *phenyl biguanide hydrochloride (IV)* — 10 5 gm of 8 amino 6-methoxy quinoline hydrochloride 3 gm of phenyl dicyandiamide and 60 c c absolute alcohol were taken in a 250 c c conical flask and refluxed for 20 hr attaching a guard tube to it The hydrochloride of the biguanide was precipitated as fine crystals This was crystallized from rectified spirit yield 2 gm m p 228° 30°C

The corresponding base was prepared by dissolving the hydrochloride in hot water and basifying by dilute caustic soda solution The base was crystallized from alcohol (95 per cent), m p, 112°-14°C (found N 24 82, $C_{18}H_{18}ON_6$ requires N, 25 1 per cent)

Preparation of N^1- (5- chloro-6-methoxy-8-amino quinolyl)-N^5-phenylbiguanide (*V*) — 6 2 gm of 8-amino-6-methoxy 5-chloro quinoline hydrochloride 4 gm of phenyl dicyandiamide was taken with 300 c c absolute alcohol in a 500 c c flask and refluxed for 30 hr attaching a guard tube to it Majority of the alcohol was distilled off when the hydrochloride of the biguanide was obtained in crystalline form The hydrochloride was dissolved in hot water and basified with dilute caustic soda solution The base crystallized from alcohol in clusters m p 177°-79°C (decomp) yield 1 5 gm (found N 22 92, $C_{18}H_{17}ON_6Cl$ requires N, 22 8 per cent)

Preparation of N^1 (5 chloro 6-methoxy 8-amino quinolyl) N^5-p-chloro phenyl biguanide (*VI*) — This compound was prepared in the above way by taking 6 2 gm 8 amino-6-methoxy 5-chloro quinoline hydrochloride 4 9 gm *p*-chloro phenyl dicyandiamide and 250 c c absolute alcohol The base was isolated in the usual way m p 196°-98°C (decomp) yield 5 gm (found N 21 0, $C_{18}H_{16}ON_6Cl_2$ requires N 20 84 per cent)

Preparation of N^1 (5 *chloro* 6-*methoxy* 8-*amino quinolyl*)-N^5 *p-methoxy phenyl biguanide* (*VII*) — Prepared in the usual way from 6 2 gm 5-chloro 6-methoxy quino line hydrochloride 4 75 gm *p*-methoxy phenyl dicyandiamide and 250 c c absolute alcohol The base melted at 192°-94°C (decomp), yield 2 gm (found N 21 52 $C_{19}H_{19}O_2N_6Cl$ requires N, 21 61 per cent)

Preparation of N^1-(5-*chloro*-6 *methoxy 8-amino quinolyl*) N^5-*m-chloro phenyl biguanide* (*VIII*) — By refluxing a mixture of 6 2 gm 5-chloro-6-methoxy quinoline hydrochloride, 4 9 gm m-chloro phenyl dicyandiamide and 250 c c alcohol for a period of 32 hr, the hydrochloride was isolated on crystallization from alcohol (95 per cent) and melted at 238°-39°C yield 2 0 gm (found N, 21·22, $C_{18}H_{16}ON_6Cl_2$ requires N, 20 84 per cent)

Pharmacological Study

The compounds (I), (II), (VI) and (VII) have been studied and the result of investigations so far carried out are recorded below

James[11] showed that plasmoquin could exert a causal prophylactic action against human malaria, though the dosage necessary for such action was very much near the toxic dose It is agreed that the true antimalarial would be a drug which could act as a true prophylactic Some gametocidal drugs have been found in the laboratory to exert a sporozoiticidal and thus a prophylactic action in birds Endochin or 2 3 dialkyl 4-hydroxy quinoline has been reported by Kikuth[12] to give a causal prophylactic effect in birds as well as gametocidal activity and clinical cures From these it appears probable that for possessing a true prophylactic action an anti malarial drug should also exert a high degree of gametocidal activity While plasmoquin shows a powerful gametocidal as well as some sporozoiticidal action in human malaria its action against the gametocytes of *Haemoproteus columbae* of pigeons is not of a high order It has been shown[13] that while the propyl derivative of plasmoquin has a powerful gametocidal activity in pigeons the action is of a short duration only None of the compounds studied so far against the gemetocytes of *Haemoproteus columbae* has shown any lasting gametocidal action We believe that the gametocytes of *Haemoproteus columbae* being very resistant a drug successful in eliminating the gametocytes would be likely to have widespread significance in anti malarial action

Preliminary tests for possible gametocidal activity of these drugs were carried out on *Haemoproteus columbae* infection of pigeons according to the method previously described[13] The drugs were fed orally as balls mixed with dextrose in doses varying from 5 to 10 mg per 100 gm body weight of animals daily for 5 consecutive days Gametocyte counts were done daily after drug administration The findings are being recorded in Table I From the table it would be noticed that amongst the various products the compound (I) exerts a definite gametocidal activity as shown by a marked reduction of gametocyte count after drug feeding The gametocytes, however, tend to increase again after a varying period of time on cessation of drug administration No untoward reactions were noted in experimental pigeons

In order to completely free the animals from the gametocytes, some animals were

TABLE I — EFFECT ON THE GAMETOCYTES OF *HAEMOPROTEUS COLUMBAE* OF NATIVE PIGEONS

DRUG No	DAILY DOSE FOR DAYS, mg / 100 gm	AVERAGE PERCENTAGE OF GAMETOCYTES FROM 3 EXPERIMENTS							
		Initial	After drug treatment, days						
			1	2	3	4	5	6	7
I	5	2 2	1 3	1 1	1 0	0 8	0 8	0 9	0 7
	10	2 0	0 6	0 4	0 2	0 8	1 0	0 5	0 2
II	10	4 2	4 1	3 9	3 7	3 0	3 8		4 0
VI	5	2 0	1 8	1 8	1 3	3 0	2 2		1 8
VII	5	5 2	6 7	6 0	5 5	4 3	5 5		2 8

treated with intramuscular injection of the compound (I) in dosage of 25 mg /100 gm In this experiment also, it was found that while the gametocytes diminished to a great extent, complete freedom from gametocytes could not be attained in the blood The parasites, however, showed more pigmentation and vacuolation after the drug treatment

Tests for chronic toxicity were also carried out on growing mice (10-12 gm) with the compound (I) and (II) by the drug-diet technique of Bratton[14] The drugs formed 1 per cent in diet There was profound anorexia in the test animals of both the groups as shown by the restricted intake of diet There was, however, no mortality in any of the drug groups.

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Studies in the Constituents of *Chana* (*Cicer arietinum*, Linn.) — Part III: Chemical Examination of the Fixed Oils from *Chana* & *Kabuli Chana* (Ordinary & White Varieties)

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The physical properties and chemical composition of the fixed oils extracted from the 2 varieties of *Cicer arietinum* Linn., viz. *chana* and *Kabuli chana*, are nearly identical. Both are semi-drying oils (iod. val, 117·7 and 113·2) and contain β-sitosterol, 2·9 per cent and 3 2 per cent on the weight of the oil.

THE two preceding communications of the series[1] dealt respectively with the isolation of biochanins A, B and C and the constitution of biochanin A The present paper embodies the results of investigations of the fixed oils from *chana* and *Kabuli chana*

Zlataroff[2] made a study of the Bulgarian chick-pea (*Cicer arietinum*, Linn) fat and determined its various constants. He also noted the change that takes place in the constants of the fat when chick-pea is roasted to prepare *leblebiji*, which is extensively used as an article of diet in southern

Bulgaria. From the unsaponifiable part of the fat he isolated "slanutosterol" and described it as an isomer of phytosterol Investigations of Nag and Banerji[8] on *chana* and *Kabuli chana* oils revealed that the oil from the latter approached cod liver oil of approved quality in vitamin efficiency, and that absorption spectra of both the oils showed bands corresponding to those of the spectrum of cod liver oil

In view of the earlier findings of Nag and Banerji and the lack of any reference in literature on a systematic chemical examination of the fixed oils from *chana* and *Kabuli chana*, both of which are important articles of diet in India, it was considered of interest to make a study of these oils As a result of these investigations which were carried out with the solvent-extracted oils and are described in detail in the experimental, it was found that the overall composition of the two oils is nearly identical but differs widely in certain aspects from that of the Bulgarian chick-pea fat examined by Zlataroff, particularly in the sterol content and the saponification and iodine values These differences have been recorded in Table I The sterols from both the oils were found to be identical with β-sitosterol A detailed examination of the unsaponifiable matter of the oils with special reference to its nutritive value and vitamin efficiency is in progress

A colourless crystalline substance, m p, 256°-57°C, was also isolated from the alcohol-soluble portion of *chana* oil through partitioning of the oil in petroleum ether and 70 per cent alcohol, but its quantity was too small for further study

Experimental

Extraction of the Oils — Well-powdered *chana* (4 kg) was percolated five times with petroleum ether (b p 40°-70°C) at room temperature (20°-25°C), which effected nearly complete extraction of the oil On removal of petroleum ether from the combined percolates on the water bath, the last traces of the solvent and moisture being removed *in vacuo* in a current of carbon dioxide, *chana* oil was finally obtained as a viscous brownish-yellow liquid (yield, 164 gm, 4 1 per cent) It exhibited a greenish fluorescence and had a characteristic smell

Kabuli chana (4 kg), on following the same procedure of extraction, yielded a slightly less viscous lighter coloured oil, which did not exhibit any fluorescence (yield, 200 gm, 5 0 per cent)

Examination of the Oils — The oils do not contain any nitrogen or sulphur and burn with a semi-sooty flame In order to test the drying power of the oils, a few drops of each were spread in thin films on two glass slides and kept at the room temperature Both the films became very sticky at the end of 8-10 days, which showed they both belonged to the class of semi-drying oils The physical and chemical constants of the two oils are given in Table I, along with those of the Bulgarian chick-pea fat (after Zlataroff) The sterol content of the oils were determined by weighing out the sterol obtained from the unsaponifiable matter by crystallizing through alcohol

TABLE I

	Chana OIL	*Kabuli chana* OIL	CHICK PEA FAT (Zlataroff)
Specific gravity	0 9356 (at 40°C)	0 9301 (at 40°C)	0 9364 (at 15°C)
Refractive index	1 4845 (at 38°C)	1 4825 (at 38°C)	
Saponification value	184 6	185 4	240
Acid value	2 4	2 6	7 0
Iodine value (Wijs)	111 7	113 2	129 0
Reichert Meissl value	0 61	0 60	4 3
Polenske value	0 38	0 40	1 6
Unsaponifiable matter, %	3 4	4 0	
Sterol content, %	2 9	3 2	0 3

Chana oil (150 gm) was saponified with alcoholic potassium hydroxide (4 per cent) in the usual manner and the excess of alcohol distilled off on the water bath The soap was dissolved in water and repeatedly extracted with ether to remove the unsaponifiable matter The extracted soap solution was taken in a separating funnel, covered with petroleum ether and decomposed with dilute sulphuric acid After shaking carefully, the petroleum ether layer containing the total fatty acids was removed, dried over calcium chloride and freed of the solvent on the water bath The last traces of the solvent were removed by passing a stream of carbon dioxide through the concentrate kept at 100°C, finally in a vacuum desiccator The yield of the total fatty acids was 137·7 gm (91 8 per cent)

Kabuli chana oil (150 gm), on similar treatment, yielded 138 2 gm of total fatty acids (92 1 per cent). Table II gives the constants of the total fatty acids from the oils

TABLE II

	Chana OIL MIXED FATTY ACIDS	*Kabuli chana* OIL MIXED FATTY ACIDS
Consistency	viscous liquid	viscous liquid
Neutralization value	201 8	201 2
Mean molecular weight	278 7	278 9
Iodine value (Wijs)	118 4	119 7

TABLE III

	SATURATED ACIDS		UNSATURATED ACIDS	
	Chana	*Kabuli chana*	*Chana*	*Kabuli chana*
Percentage in total fatty acids	9 9	9 7	90 1	90 3
Percentage in oil	9 1	9 0	82 7	83 1
Mean molecular weight	256 1	255 8	281 1	281 5
Iodine value (Wijs)	2 9	2 7	129 6	130 3

The total fatty acids from *chana* and *Kabuli chana* oils (125 gm each) were separated into saturated and unsaturated acids by Twitchell s modified lead salt-alcohol method[4] Table III gives the percentages mean molecular weights and iodine value of the saturated and unsaturated acids in each case

Examination of the Unsaturated Acids — The method of Jamieson and Baughmann[5] was followed for the separation and estimation of unsaturated acids Total unsaturated acids from *chana* oil (4 9095 gm) were dissolved in dry ether (100 c c) and the solution was cooled in a freezing mixture to —10°C Dry ethereal bromine (*c* 2 5 per cent) was added drop by drop to the well cooled solution till it was in excess During the addition of bromine the temperature of the solution was not allowed to rise above —5°C The mixture was then allowed to stand for 4 hr at —10°C During this period no crystalline matter separated out indicating the absence of linoleic acid in the oil The ethereal solution was then freed from excess of bromine by shaking it with aqueous sodium thiosulphate After drying the solution over calcium chloride ether was removed on the water bath The residue was dissolved in dry petroleum ether (200 c c) and kept in a refrigerator for 24 hr when crystals of a bromo derivative m p 110°-12°C separated out which was identified as tetrabromo-linoleic acid The crystals were filtered dried and weighed The filtrate was freed of the solvent on the water bath, finally *in vacuo*, and the bromine content of the residue estimated The percentages of tetrabromo-linoleic acid and dibromo-oleic acid in the residue was calculated from the bromine content Similar estimations were also made in the case of unsaturated acids from *Kabuli chana* oil The results of these analyses are given in Table IV

The percentage of oleic and linoleic acids in the total unsaturated acids total fatty acids and in the two oils are given in Table V.

Examination of the Saturated Fatty Acids — For the separation and identification of individual saturated fatty acids the total saturated acids were converted into the methyl esters 10 05 gm of the total saturated acids from the *chana* oil were refluxed with pure methanol (85 c c) and concentrated sulphuric acid (1 25 gm) for 4 hr on the water bath The excess of methanol was distilled off and the residue poured into water (125 c c) The liquid was neutralized with sodium bicarbonate and extracted with ether The ethereal extract containing the esters of the saturated fatty acids was washed with water and then with a solution of calcium chloride to remove methanol and finally again with water The extract was dried over anhydrous sodium sulphate and freed of the solvent on the water bath The total methyl esters (10 26 gm)

TABLE IV

	Chana OIL	*Kabuli chana* OIL
Weight of total unsaturated acids gm	4 9095	4 7296
Weight of tetrabromo linoleic acid insoluble in petroleum ether gm	1 7040	1 2610
Weight of residue (dibromide and tetrabromide) gm	7 1760	7 5100
Bromine content of the residue %	42 81	43 77
Weight of dibromo oleic acid gm	4 4500	4 2830
Weight of tetrabromo linoleic acid in the residue gm	2 7260	3 2770
Weight of total tetrabromo linoleic acid gm	4 4300	4 5380
Weight of oleic acid equivalent to dibromide gm	2 8390	2 6690
Weight of linoleic acid equivalent to tetrabromide gm	2 0670	2 1160

TABLE V

	OLEIC ACID IN		LINOLEIC ACID IN	
	Chana oil	*Kabuli chana* oil	*Chana* oil	*Kabuli chana* oil
% in total unsaturated acids	57 82	55 70	42 18	44 30
% in total fatty acids	52 10	50 30	38 00	40 00
% in oil	47 82	46 29	34 88	36 81

thus obtained were fractionally distilled under reduced pressure (8 mm.) and separated into four fractions. The saponification value of each fraction was determined and the mean molecular weight of the esters and corresponding acids in each fraction calculated. Total saturated fatty acids (10 52 gm) from *Kabuli chana* oil similarly yielded 10 91 gm of total methyl esters which were similarly fractionated. The results are given in Table VI.

TABLE VI

FRACTION	BOILING RANGE AT 8 mm., °C.	WT OF THE DISTILLATE gm	SAPONIFICATION VALUE	MEAN MOLECULAR WEIGHT		ACIDS %			
				Esters	Acids	Myristic	Palmitic	Stearic	Arachidic
Esters of Saturated Acids from *Chana* Oil									
1	165 85	2 4905	226 0	248 2	234 2	77 85	22 15		
2	185 95	2 5145	210 7	260 2	246 2	34 99	65 01		
3	195 205	3 7140	200 5	279 9	265 9		64 65	35 35	
4.	Above 205	1 5105	189 1	296 7	282 7		46 41	53 59	
Esters of Unsaturated Acids from *Kabuli Chana* Oil									
1	170 98	7 2544	210 7	260 2	246 2	34 99	65 01		
2.	198 208	2 4488	200 3	280 2	266 2		63 55	36 45	
3.	208 10	0 8752	190 4	294 6	280 6		11 99	88 01	
4	Above 210	0 2048	181 9	308 4	294 4			62 85	37 15

The various fractions of the esters were separately hydrolysed with alcoholic potassium hydroxide and the liberated acids extracted with ether and repeatedly crystallized from alcohol. Myristic, palmitic and stearic acids were obtained in the pure condition and identified Table VII gives the composition of the saturated fatty acids in *chana* and *Kabuli chana* oils

TABLE VII

ACIDS	% IN MIXED SATURATED ACIDS	% IN TOTAL FATTY ACIDS	% IN OIL
***Chana* oil**			
Myristic	27 68	2 74	2 52
Palmitic	51 59	5 11	4 69
Stearic	20 73	2 05	1 87
***Kabuli chana* oil**			
Myristic	23 51	2 28	2 12
Palmitic	59 19	5 74	5 33
Stearic	16 61	1 61	1 50
Arachidic	0 69	0 07	0 06

Examination of the Unsaponifiable Matter—The unsaponifiable matter from *chana* oil was obtained by extracting the saponified oil with ether The combined ether extract was repeatedly washed with water and freed of the solvent on the water bath The yellowish-brown residue thus obtained yielded colourless needles of a product, m p , 138°-39°C., which gave the usual tests for sterols (yield, 2 9 per cent on the weight of the oil) It showed $[\alpha]^{30°}_{D}$ = −36 15° and yielded a crystalline digitonide The analytical data, optical rotation and melting point indicated that the substance is identical with β-sitosterol Found C, 84 2 , H, 12 4 , $C_{29}H_{50}O$ (β-sitosterol) requires C, 84 1 , H, 12 1 per cent

The acetyl derivative of the sterol prepared in the usual manner crystallized from alcohol in colourless flakes, m p , 125°-26°C , $[\alpha]^{30°}_{D}$ = − 39 2° The analytical and other data agree with acetyl-β-sitosterol Found C, 81 4 , H, 1 5 , $C_{31}H_{52}O_2$ (acetyl-β-sitosterol) requires C, 81 6 , H, 11 4 per cent

The unsaponifiable matter from *Kabuli chana* oil, on working up in the same manner, also yielded β-sitosterol (yield, 3 2 per cent)

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Restricted Hydrogenolysis of High Sulphur Coal from Assam, India

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Studies on the hydrogenation of a Tertiary Assam coal of unusually high sulphur content show that in the presence of Adkins' catalyst and at 375°C more than 80 per cent of the carbon and nitrogen and less than 15 per cent of the oxygen and sulphur, originally present in the coal, were recovered in the hydrogenation oils.

DURING an investigation of the rôle of coal sulphur in the hydrogenation of three selected samples of Pittsburgh Seam coal of varying sulphur content[1], it seemed pertinent to extend this study to include the hydrogenation of a Tertiary Indian coal of unusually high sulphur content from the 20-ft Seam, Ledo, Assam

Experimental

A stock mixture of the coal (TABLE I for analysis) and catalyst was prepared by grinding 300 gm of –200 mesh coal and 60 gm of Adkins' catalyst[2] (calcium copper chromite) together in a ball mill for 48 hr A portion of this mixture (120 gm) was then hydrogenated for 72 hr at 375°C using the procedure of Neuworth[3] The specially designed autoclave with a cold-head receiver[1] is sketched diagrammatically in Fig 1 and is shown assembled in Fig 2

TABLE I — ANALYTICAL DATA ON COAL USED*

Proximate Analysis

	AS RECEIVED	MOISTURE FREE	ASH, MOISTURE FREE
Moisture	1 5		
Volatile matter	46 3	47 0	47 9
Fixed carbon	50 5	51 3	52 1
Ash	1 7	1 7	

Ultimate Analysis

	AS RECEIVED	MOISTURE FREE	ASH, MOISTURE FREE
Carbon	75 1	76 3	77 6
Hydrogen	5 5	5 4	5 5
Nitrogen	1 1	1 1	1 1
Sulphur	7 5	7 7	7 8
Oxygen	9 1	7 8	8 0
Ash	1 7	1 7	
B T U /lb	13910	14130	14380

Real specific gravity — 1 30

Fusibility of Ash

Initial deformation temperature	2,060°F
Softening temperature	2,360°F
Fluid temperature	2,620°F

Sulphur Forms

	SULPHATE	PYRITIC	ORGANIC
As received	0 09	0 32	7 13
Moisture-free	0 09	0 32	7 24
Ash and moisture free	0 10	0 33	7 37

*Courtesy U S Bureau of Mines, Pittsburgh, Pennsylvania

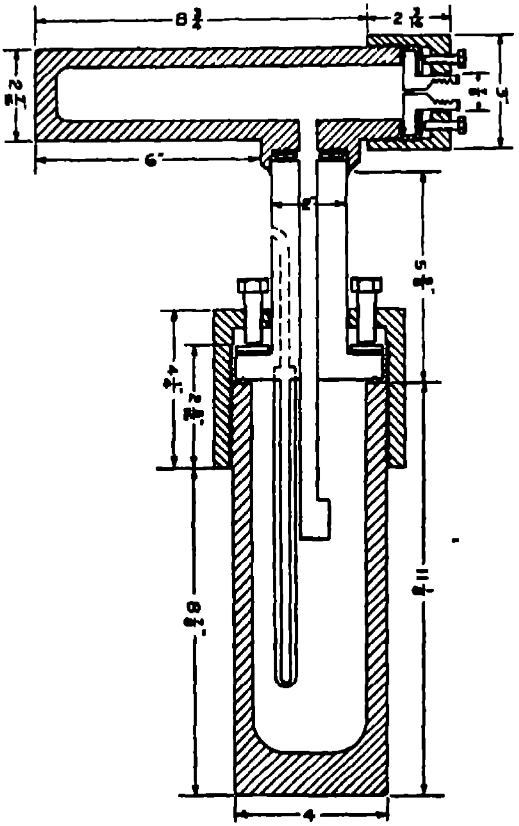

FIG 1 — DIAGRAM OF HYDROGENATION AUTOCLAVE WITH COLD-HEAD RECEIVER

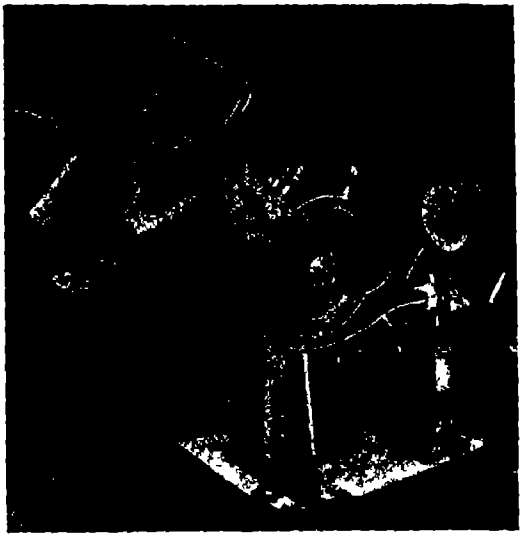

FIG 2 — PHOTOGRAPH OF THE ASSEMBLED HYDROGENATION AUTOCLAVE

The cold hydrogen pressure of the autoclave as charged was 1,800 p s i which, at reaction temperature, increased to approximately 3,300 p s i

The treatment of the coal and of the resultant products is shown in the flow diagram in Fig 3 on a basis of 100 parts of ash and moisture-free coal

The organic phase (PHP), recovered as distillate in the cold-head receiver, was treated with 10 volumes of pentane with vigorous agitation to precipitate the pentane-insoluble material (PHP-Bitumen) After standing overnight, the supernatant solution was removed by decantation, and the PHP-Oil recovered by removal of the solvent pentane was subjected to chromatography The column (53 5 × 4 cm) was filled with alumina-Super-Cel (1 1) and pentane was used as the solvent and developer[3]

Discussion

This high-volatile, high-sulphur, high-oxygen Indian coal gave the highest yield of pentane-soluble oil obtained so far in the many investigations at the Coal Research Laboratory[3,4], namely 76 2 per cent based on amf coal (TSR- and PHP-Oil) Furthermore, the conversion of the coal to soluble and/or gaseous products apparently was complete within experimental errors since the insoluble material recovered from the residue (TIR) was approximately equal to the calculated value of the sum of the reduced catalyst plus ash The yield of gases by difference (7 6 per cent) also is the lowest for all other hydrogenations at 375°C made so far at the Coal Research Laboratory

It appears that this high-sulphur coal is particularly amenable to hydrogenation However, other work[1] indicates that this is not a generalization The nature of the organic sulphur linkages, and thus the chemical structure of the coal, may be an important factor in the hydrogenolysis of coal This is supported by the fact that whereas 80-82 per cent of the carbon and nitrogen appears in the PHP-Oil, only 12-15 per cent of the sulphur and of the oxygen was recovered therein, indicating that the carbon to sulphur and the carbon to oxygen bonds are ruptured relatively easily

The results from the further resolution of the PHP-Oil by chromatography on alumina are in general very much the same as those which have been observed on the hydrogenation products from other bituminous coals The appearance of the chromatogram (TABLE II) and the analytical data (TABLE III) are all consistent with previous results However, the material in Band IV has a somewhat lower molecular weight, a lower hydrogen to carbon ratio and a lower acetylatable hydrogen content than that observed generally for Band IV from other hydrogenations

The distribution of material and of the various elements (TABLE IV) shows that of the 82 per cent of the carbon in the PHP-Oil, more than three-fourths of it appears in the non-hydrocarbon fractions — Bands III and IV — together with more than nine-tenths of the nitrogen, sulphur and oxygen recovered in the PHP-Oil This emphasizes further the importance of these hetero-atoms in the structure of the primary units of coal and the

TABLE II — DATA & RESULTS FROM CHROMATOGRAPHY OF PHP-OIL

BAND No	LENGTH OF BAND cm	PER CENT*	APPEARANCE IN	
			Ordinary light	Ultra violet light
IV	18	34 2	Light brown + greyish brown	Grey violet
III	10	39 5	Yellow + brown	Yellow + brown
II	8	15 3	Colourless	Blue
I	17 5	7 0	Colourless	Colourless
Loss		4 0		

* Based on 60 0 gm of PHP Oil

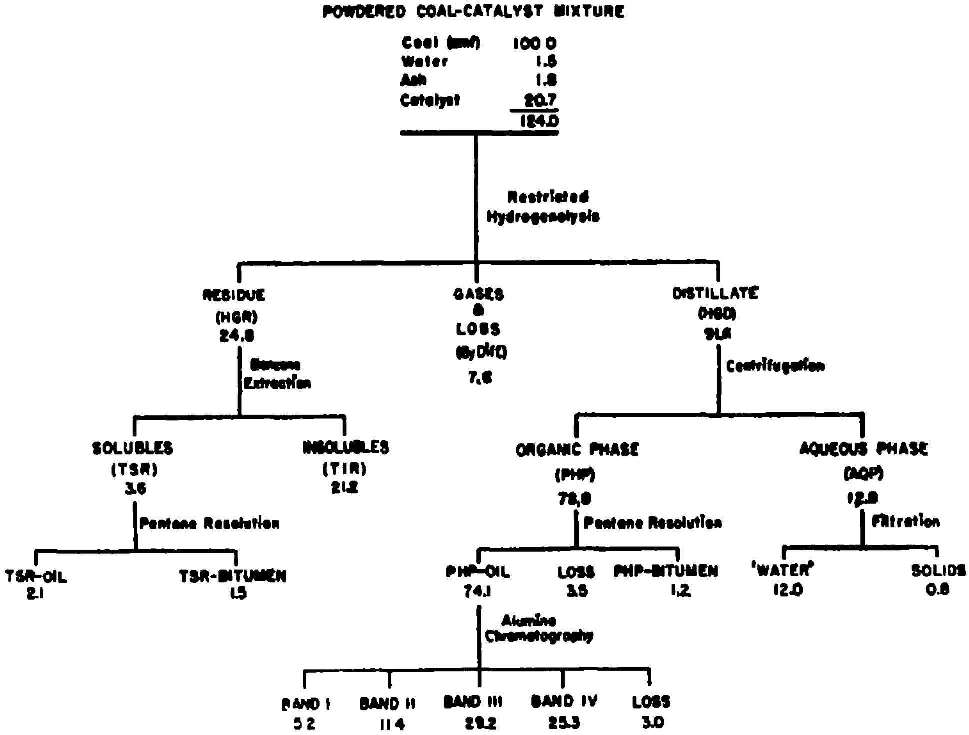

FIG 3 — FLOW DIAGRAM AND DISTRIBUTION OF PRODUCTS

need for a further understanding of the chemistry of these materials

Summary

The study of the rôle of sulphur in the hydrogenation of coal with Adkins' catalyst has been extended to include the hydrogenation at 375°C of a very high-sulphur coal from Assam, India Essentially, complete conversion of the coal to soluble products was observed — the yield of oil being the greatest and the yield of gas being the

TABLE III — ANALYTICAL DATA ON FINAL FRACTIONS OF HYDROGENATION PRODUCTS

	MOL * WT	ULTIMATE COMPOSITION, %†					ACTIVE H/mole ‡	H/C	AVERAGE FORMULA, ATOMS/MOLE				
		C	H	N	S	O			C	H	N	S	O
Distillate													
PHP		85 68	9 43										
PHP Oil	247	86 49	9 56	1 20	1 18	1 57	0 27	1 33	17 6	23 6	0 2	0 1	0 2
I	244	85 91	11 39	0 46	0 69	1 55		1 58	17 5	27 6	0 1	0 1	0 2
II	268	86 62	9 46	0 89	1 60	−0 57		1 42	17 8	25 3	0 2	0 1	
III	278	85 12	8 39	1 65	1 06	3 78	0 11	1 18	19 7	23 2	0 3	0 1	0 7
IV	216	80 52	8 49	1 77	1 54	7 68	0 54	0 99	14 5	14 3	0 3	0 1	1 0
PHP Bitumen		80 78	6 80	1 85	1 16	9 41							
Residue													
HGR		13 6§											
TSR-Oil		89 66	8 47	0 66	0 96	0 23							
TSR Bitumen		91 78	6 32	0 55	0 41	0 94							
TIR		5 0§											

* As determined ebullioscopically in benzene.
† Average of duplicate analysis by University of Pittsburgh
‡ As determined with acetic anhydride-pyridine reagent
§ Average of duplicate analysis for carbon by wet combustion.

TABLE IV — DISTRIBUTION OF MATERIAL & ELEMENTS IN CHROMATOGRAPH FRACTIONS

FRACTION	WEIGHT		CARBON		HYDROGEN		NITROGEN		SULPHUR		OXYGEN	
	gm	%	gm	%	gm	%	gm	%	gm	%	gm	%
PHP	78 8	78 8*	67 6	87 1*								
PHP Oil	74 1	74 1*	68 9	82 3*	7 0	127 5*	0 89	80 8*	0 87	11 8†	1 16	14 5*
Band I	5 2	7 1	4 5	7 5	0 7	10 9	0 02	2 5	0 04	4 8	0 08	2 6
Band II	11 4	15 6	10 1	16 9	1 1	17 1	0 01	1 1	0 02	2 4		
Band III	29 2	40 0	24 7	41 4	2 4	38 4	0 48	50 0	0 31	41 2	1 11	35 3
Band IV	25 3	34 6	20 4	34 2	2 2	33 6	0 45	46 4	0 39	51 6	1 95	62 1
Loss	3 0		4 2		0 6		+0 08		0 12		+1 98	

* Based on 100 gm of starting amf coal, all others on material recovered unless noted.
† Based on amount of organic sulphur in starting amf coal

smallest for any coal studied so far at the Coal Research Laboratory Less than 15 per cent of the oxygen and of the sulphur and more than 80 per cent of the carbon and nitrogen originally present in the coal were recovered in the hydrogenation oils

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Production of White Lead by Electrolysis: Part I — Preliminary Investigation of a Non-diaphragm Process

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White lead of the composition $2PbCo_3$, $Pb(OH)_2$ is obtained by the electrolytic process using a non-diaphragm single fluid cell, sheet lead electrodes, a bath containing 0·5 electrolyte (sod. bicarbonate, 1 part, sodium carbonate, 2 parts, sodium acetate, 10 parts) and current densities ranging from 0·0093 to 0 016 amp./sq inch.

ELECTROLYTIC white lead possesses several advantages over that produced by the usual Dutch process It is of exceptional purity, brilliance, whiteness and uniformity The electrolytic process enables the production of white lead of physical properties varying over a wide range[1]

Several electrolytic processes have been developed and patented These are (1) diaphragm processes, using anodes of lead and cathodes of other metal as in the Sperry process[2,3]; (2) using electrodes of lead only, the direction of current being reversed periodically or not[4 7], (3) electrolysis is employed only to obtain a solution of lead from which white lead is subsequently precipitated outside the cell[8], (4) lead is reduced electrolytically to a colloidal galvanic deposit and then converted into white lead by carbon dioxide[9,10], and (5) conversion of recovered lead amalgam to white lead[11]

Electrolytically refined lead bullion has been used for white lead production[12] The danger of discolouration of the product by impurities from the electrodes has been pointed out[13] However, it has since been recognized that commercial lead could be used without purification The lead is dissolved out while the other metals remain on the anode surface in the form of a hard film[1]

There is considerable diversity in the electrolyte used as well as the bath composition employed Operating conditions of the cell such as E M F and current density also vary considerably Sulphonated soaps have been added to the bath to improve the quality of the white lead[10,14]

In the Sperry process the anolyte consists of 3 to 5 per cent sodium acetate with traces of sodium carbonate and bicarbonate, while the catholyte consists of 1 to 3 per cent sodium acetate, 7 to 14 per cent sodium carbonate and about 0 5 per cent sodium hydroxide The electrolyte is rapidly circulated around the electrodes The catholyte is carbonated and the electrolysis is carried out at 40°C

Pamfilov and Iobinov[8] used sodium acetate solutions as the electrolyte, 10 per cent chlorate solutions were also used and a 100 per cent current efficiency was reported It was observed that black films formed on the anode, especially in alkaline solutions using high current densities Dilute solutions of sodium chlorate alone or with nitrate and charged with carbon dioxide were used as the electrolyte by Carreras[5], Nadal[6], and Devai[7] Millbauer[14] obtained a product approaching neutral lead carbonate (86 to 99 8 per cent), possessing low covering power, using sodium bicarbonate as the electrolyte The best results were obtained by electrolysing a 0 1 per cent solution of sodium bicarbonate at 16° to 20°C with current densities ranging from 0 1 to 0 9 amp /sq dm and an E M F varying between 9 to 120 volts The current was reversed every 15 min A higher sodium bicarbonate concentration (0 5 per cent) gave poor results Using a 2 per cent electrolyte containing sodium bicarbonate and sodium hydroxide in a ratio of 14 2 or 14 8, a product containing 66 4 to 61 7 per cent lead carbonate and 32 6 to 38 7 per cent lead hydroxide was obtained In the presence of 0 01 per cent gelatin, the lead hydroxide content was 36 5 per cent Addition of 0 001 per cent of a sulphonated soap gave a product containing 32 2 per cent lead hydroxide but improved the colour of the white lead as well as its covering power

It is obvious that there is wide choice in the working conditions for the production of white lead electrolytically In view of the fact that precise data on working conditions are meagre in literature, it was considered desirable to investigate independently the conditions for production of white lead

TABLE I

EXPT No	ELECTROLYTE				CURRENT DENSITY amp / sq in.	TIME hr	YIELD gm	PbCO$_3$ %	Pb(OH)$_2$ %	CURRENT EFFICIENCY	REMARKS
	NaHCO$_3$ %	Na$_2$CO$_3$ %	NaOH %	Na Ac %							
1	0 1				0 00124	2	Traces				
2	0 1				0 00339	2	do				
3	0 1			0 4	0 00930	2	2 45	82 54	17 46	82 26	
4	0 087	0 016		0 4	0 00930	3	4 34	93 93	6 07	95 45	
5	0 035	0 082		0 4	0 00930	3	3 35	65 72	34 28	77 23	The particles are too fine and do not settle very easily
6	0 035	0 082		0 4	0 01481	3	6 51	63 87	36 13	97 47	Gas evolution occurs at cathode Anode discoloured
7	0 035	0 082		0 4	0 00837	3	3 11	58 75	41 25	82 88	
8		0 1		0 4	0 01026	3	2 7	44 77	55 23	64 55	Anode coloured brown
9		0 13	0 015	0 4	0 00930	3	2 55	44 61	55 39	61 62	do
10		0 13	0 046	0 4	0 01160	3	2 66	52 0	48 00	52 74	White lead formation takes place very slowly Pigment comes down as flakes Blackening of anode
11	0 035	0 082			0 00269	2					
12	0 035	0 082			0 00396	2					
13	0 035	0 082		0 01	0 00403	3	0 4				
14	0 035	0 082		0 02	0 00403	5 5	1 10	41 78	58 22	34 1	Particles are too fine and do not settle very easily
15	0 035	0 082		0 1	0 00417	3	1 68	58 16	41 84	100 0	do
16	0 035	0 082		0 8	0 01589	2	4 5	61 75	38 25	78 18	Current and voltage varied during electrolysis as well as on change in direction of current, copious evolution of gas at cathode; browning at anode

Experimental

Electrolytic Cell — The cell consists of a rectangular glass vessel (9 5″×5 5″×11″) provided with two electrodes of sheet lead (11 2″×5·4″) cut into T-form and an electric stirrer To provide for efficient circulation holes are punched in the electrodes Current is supplied from lead storage cells

Electrolysis — In each experiment the volume of the electrolyte used was 5 litres The composition of the electrolyte used in different experiments is given in Table I The alkalinity was varied by adding measured volumes of standard sodium hydroxide to the bicarbonate solution (0 1 per cent) with or without sodium acetate The voltage of the cell in all cases was maintained at 6 By including a commutator in circuit, the current was reversed every 15 min Current density was varied by altering the distance between the electrodes as well as by changing the composition of the electrolyte The electrolyte was kept stirred continuously during the electrolysis

The product obtained in each case was filtered, washed, dried in a steam oven and analysed for total lead by Hempel's method[15] and for carbon dioxide using Schrotter's apparatus[16,17]

Current efficiencies were calculated on the lead dissolved out of the electrodes in the course of electrolysis The results obtained in the course of the investigation are given in Table I

In the above series of experiments a sudden increase in the amperage immediately after the current is reversed was observed

Discussion

Electrolysis of a 0 1 per cent solution of sodium bicarbonate produced no precipitate of white lead, but on the addition of sodium acetate (0 4 per cent) a product with a high lead carbonate content (82 54 per cent) separates out On partial neutralization of the sodium bicarbonate in the above mixture the lead carbonate content rises to 93 9 per cent A further increase in the proportion of sodium carbonate at the expense of bicarbonate reduces the lead carbonate value to 65·72 per cent, current density remaining the same An increase in current density does not produce any marked change in the lead carbonate content (63 87 per cent), but gas evolution occurs at the cathode A decrease in current density, however, decreases the lead carbonate content to 58 75 per cent Electrolysis of a 0 1 per cent solution of sodium carbonate in presence of sodium acetate (0 4 per cent) produces a big drop in the lead carbonate content (44 77 per cent) It should be noted that this solution contains no bicarbonate ions and is relatively much more alkaline A further increase in the alkalinity (a mixture of sodium carbonate, hydroxide and sodium acetate) does not produce a marked change in the lead carbonate content A still further increase in the alkalinity and in current density produces a pigment with a higher lead carbonate content (52 0 per cent) The pigment, however, comes down in flakes and blackening of the anode takes place

The part played by sodium acetate is clear from the data (experiments 11 to 16) In the absence of sodium acetate no precipitation occurs Addition of sodium acetate, however small in quantity (0 01 per cent), immediately produces a precipitate, although small in bulk As sodium acetate content is increased precipitation begins A 100 per cent current efficiency is reached with a concentration of 0 1 per cent sodium acetate White lead close to the theoretical composition is produced with 0 4 per cent sodium acetate concentration Increasing the concentration to 0 8 per cent does not produce a very marked change in the composition of the precipitate The current efficiency obtained depends upon both the sodium acetate concentration as well as the current density employed

The author wishes to thank Prof K Neelakantam for suggesting the problem and for his keen interest in the work

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Toxicity of Nickel*

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The toxicity of nickel was tested using albino rats and monkeys as experimental animals and nickel carbonate, nickel soaps of mixed acids of refined arachis oil, and nickel catalyst suspended in oil and supported on kieselguhr as test materials. The dosage tried was 100 mg, 50 mg and 25 mg of adequate ration Growth rate and reproduction performance were not significantly affected and no toxicity symptoms were observed in rats even after 3 to 4 months of continuous feeding The retention of nickel for the 3 nickel preparations was highest with nickel carbonate. Appreciable amounts of nickel were found in the intestines and excreted in faeces. Adult monkeys maintained their weight and were in perfect health after 6 months of feeding on nickel-containing diets.

NICKEL does not, so far as is known, play any part in human or animal nutrition or in plant growth and no diseases of plants or animals have been attributed to the lack of it Its interest to the nutrition worker arises from its frequent use as the pure metal, as nickel plate, or as a constituent of alloys in the construction of plant and vessels in food industries and for cooking and also as a catalyst in the hydrogenation of edible oils

Nickel is found in some plants and animal organs as a trace element Vegetables[1] like lettuce, cabbage, spinach and peas contain from 1 5 to 3 0 p p m, wheat 0 35 and fruits 0 15 to 0 25 p p m In potatoes about 0 25 p p m is found According to Ramage[2] nickel occurs in a number of spices and herbal drugs and also is present in tea

Some nickel is likely to be dissolved if strongly acid food is cooked in nickel or nickel-plated vessels but no poisoning from such usage has been reported owing probably to the fact that nickel salts are little absorbed or because the quantity thus absorbed is too small Lehmann[3] found that food cooked in nickel utensils took up from 10 to 58 p p m and he calculated that if nickel-ware was used exclusively in the kitchen, the total amount of nickel ingested daily would be about 117 mg Cox[4] states that a beverage brewed in nickel contained 60 p p m

According to Arnold[5], a daily dose of 80 mg. of nickel in the form of nickel pectinate given to young rats, corresponding to 1 25 gm per kilogram of body weight, did not affect their rate of growth over a period of 8 weeks Flinn and Inouye[6] found that nickel was excreted to the extent of 98 to 99 per cent in faeces On the other hand, Kent and McCance[7] found in an experiment on the normal men with a nickel intake of 0 3 to 0 5 mg daily that roughly two-third of the nickel was excreted in the urine and only one-third in the faeces But their experiment did not show what would be the proportion at higher rates of intake

According to Dzerzgowsky[8], doses of 10 to 20 mg of nickel per kilogram of body weight causes no toxic symptoms in dogs, but 22 to 44 mg per kilogram produces vomiting and diarrhoea Injection of nickel salts in animals gives rise to toxic symptoms[9] It is stated that Offerdahal[10] in 1913 took 0 5 gm of powdered metallic nickel daily for a month without any ill effects

The present problem arose out of the fear in the public mind that the use of nickel catalyst in the hydrogenation of oils was likely to leave small amounts of this metal in the finished product and that ingestion of the latter over prolonged periods might give rise to nickel poisoning

In refined hydrogenated oil, the amount of nickel should be considerably less than one part per million[11, 12] In India over a 100 samples have been recently analysed by Banerjee[13] and the highest value found in any sample was 0 4 p p m

It was, however, considered worth while to test the effect of nickel administered to young rats and monkeys in the form of nickel salts or colloidal nickel in fairly large doses in order to find out if toxic effects could be elicited after continued ingestion for prolonged periods

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* An enquiry under the *Council of Scientific & Industrial Research*

The small amount of nickel in the finished hydrogenated oil when present is mainly in the form of finely divided metal, e g nickel catalyst But there may be a possibility of formation of nickel soaps by interaction of free fatty acids with metallic nickel if the oil has not been carefully refined before hydrogenation On the other hand, the presence of nickel in the ingested hydrogenated fat would render the possibility of nickel salt and soap formation during the process of digestion not altogether remote Therefore, experiments were undertaken to test the effect of feeding to rats and monkeys nickel catalyst, nickel soaps and nickel carbonate.

Nickel Catalyst — This was finely divided nickel suspended in vegetable oil and supported on kieselguhr It was kindly supplied by the *Hindustan Vanaspati Manufacturing Co Ltd*, Bombay, on request The nickel content of the catalyst was determined and found to be 19 17 per cent Ash content was 40 86 per cent

Nickel Soaps — These soaps were prepared by neutralizing with nickel carbonate the mixed fatty acids obtained on saponification of refined groundnut oil The nickel content of these soaps was determined and found to be 10·20 per cent, calculated value being 9 7 per cent

Nickel Carbonate — This salt was used for comparison with the nickel catalyst and nickel soaps.

The doses of nickel preparations were adjusted at three levels, 100 mg, 50 mg and 25 mg. of nickel per 100 gm of basal diet.

Experiments on Rats

The composition of the diet given to rats was as follows

Whole wheat flour	58 parts
Bengal gram (without husk)	20 parts
Skim milk powder	10 parts
Vegetable fat (hydrogenated oil, m p. 37°C)	10 parts
Marmite	2 parts
Vitamin A	70 I U /rat/day*
Vitamin D .	13 I U /rat/day*

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* In weekly doses

A week's supply of diet was prepared at one time and stored in the refrigerator. That nickel was evenly distributed in the diet mixture is shown by the following sample analysis (TABLE I)

TABLE I — NICKEL IN DIETS

	WEIGHT OF DIET TAKEN FOR ESTIMATION gm	NICKEL EXPECTED mg	NICKEL OBTAINED mg
Group I	3 438	3 44	3 42
	4 213	4 21	4 22
Group II	5 684	2 84	2 86
	6 002	3 00	3 00
Group III	6 080	1 52	1 50
	8 432	2 11	2 12

Estimation of Nickel — Nickel was estimated in the diets, excreta and tissues colorimetrically using dimethylglyoxime[14] as the reagent In the early stages of the investigation nickel was estimated gravimetrically as NiO to check the accuracy of the colorimetric methods Having satisfied ourselves regarding the reliability of the latter, no further gravimetric estimations were done In estimating nickel in the tissues, care was taken to remove completely the interfering substances such as copper, iron and phosphate The colour obtained with the unknown was read off in a photoelectric colorimeter and results calculated by comparison with a standard curve prepared from solution made from pure nickel sulphate

Feeding with Nickel Carbonate — 32 young rats, four weeks of age, were divided into four groups of eight each, males and females being equally represented in each group, one of these groups served as control

The diets were mixed with a small quantity of water, steamed for 15 min and given *ad lib* and so was water Weights of the rats were recorded every week for eight weeks The weekly average weights for each group are given in Table II

Feeding with Nickel Soaps & Catalyst — Groups of young rats (eight in each group) of the same age as in the previous experiment were kept on the basal diet in which nickel soaps and nickel catalyst respectively were incorporated at levels similar to those used in the feeding experiments with nickel carbonate Also a fresh control group was kept This experiment was conducted in exactly the same way as the previous one

The average growth rate for each group is given in Table III

TABLE II — GROWTH OF RATS ON NICKEL CARBONATE-CONTAINING DIETS

GROUP & Ni CONTENT PER 100 GM DIET	AVERAGE WEIGHTS OF EIGHT RATS IN GM, Weeks								
	0	1	2	3	4	5	6	7	8
I — 100 mg	43 0	58	66 7	76	85	92	86	109	115
II — 50 mg	44 7	64	79 0	89	96	106	111	127	133
III — 25 mg	43 0	65	79 8	92	99	109	113	129	135
Control	44 0	68	83 0	95	107	116	121	137	147

TABLE III — GROWTH OF RATS ON NICKEL SOAP & CATALYST

GROUP & Ni CONTENT PER 100 GM DIET	AVERAGE WEIGHT PER WEEK IN GM, Weeks								
	0	1	2	3	4	5	6	7	8
Nickel Soaps									
I — 100 mg	40 6	59 8	68 5	78 6	86 5	96 5	101 0	109 6	112 9
II — 50 mg	38 0	56 1	62 7	70 8	81 5	86 7	105 6	113 3	120 6
III — 25 mg	38 1	59 7	62 6	73 7	85 1	102 0	107 0	112 8	123 2
Nickel Catalysts									
IV — 100 mg	35 1	54 2	59 1	67 2	78 8	97 3	101 7	108 5	118 2
V — 50 mg	34 1	55 8	60 1	73 5	85 1	103 0	106 0	118 6	125 2
VI — 25 mg	36 0	59 4	67 6	78 8	93 7	107 0	116 2	125 4	128 5
Controls for groups I to VI	41 9	66 5	71 2	86 1	96 0	112 0	117 0	126 7	132 6

TABLE IV — METABOLISM OF NICKEL IN RATS

GROUP No. WITH MG OF Ni/100 MG. DIET	NUMBER OF ANIMALS	FIGURES ARE FOR THE WHOLE OF FOUR DAY PERIOD				
		Food intake gm.	Ni intake mg	Urine Ni mg	Faeces Ni mg	Retention Ni mg
Nickel Carbonate						
I — 100	8	27·60	27·60	0·53	19 70	7 41
II — 50	8	39·73	19 87	0 24	15 18	4 45
III — 25	8	41·92	10 54	0 16	7·96	1 17
Nickel Soap						
I — 100	4	39 49	39 49	0 43	35·00	4·04
II — 50	4	37 72	18 86	0 22	16 25	2 39
III — 25	4	39 42	9 85	0 14	8 75	0·99
Nickel Catalyst						
IV — 100	4	38·35	38 35	0 30	34·75	3·30
V — 50	4	41·87	20·94	0 13	18 44	2·39
VI — 25	4	42·62	10 66	0·09	9·69	0 87

Food Intake of Rats — A weighed quantity of food was given daily to each animal, food left in the cage after 24 hr was collected, dried and weighed No appreciable differences in food intake were observed in the different groups

Statistical analyses of the data contained in Tables II and III showed that the observed differences between the growth of controls and various other groups in all the three experiments were not significant It can be concluded, therefore, that ingestion of nickel in the form of nickel carbonate, nickel soap or nickel catalyst at the fairly high levels tried in the experiment did not significantly affect the growth rates of the animals The difference between the growth observed on 100 mg dose of Ni as $NiCO_3$ and in controls appeared to be large, although the difference between the two groups was not statistically significant The entire nickel carbonate experiment was repeated with fresh batch of rats, and the results confirmed the findings of the first experiment

Metabolic Experiments — While the growth experiments were in progress, some of the animals were used for the study of nickel balances in the 5th and 6th weeks of feeding The animals were placed in metabolic cages and after a preliminary period of three days, urine and faeces were collected over a period of four days In the experiment with nickel carbonate, all the rats from each of the four groups were thus investigated, whereas from rats kept on nickel soap and catalyst diets, four rats from each group were studied The average figures for intake and excretions are given in Table IV

Distribution of Nickel in Tissues — From Table IV for metabolic data of nickel balances for rats, it will be clear that rats retained appreciable quantities of nickel on all the nickel-containing diets Retention on the nickel carbonate diets has been larger than with the two other nickel preparations This can be ascribed to the easy solubility of the compound in the stomach and hence easier absorption from the intestines of nickel when fed as nickel carbonate. The proportion of the ingested nickel found in faeces is the least in the nickel carbonate group The excretion of nickel in urine is only slightly higher in this group than in the other two

In view of the continuous retention of nickel albeit in small quantities, it was considered desirable to ascertain how the retained nickel was distributed among the different tissues of the body After the growth experiments were over, i e in the ninth week of nickel feeding, two rats from each of the above groups were anaesthetized and blood drawn by heart puncture, the rats then being killed by excess of the anaesthetic The following tissues were taken up for nickel determinations femora, liver, kidney, spleen, heart, large and small intestines (together), testes and skin, in addition to the blood mentioned before Nickel was determined colorimetrically after ashing and removal of interfering substances The results are given in Table V

Reproduction

After the observations on growth for eight weeks were over, males and females from the same group were paired The object of this was twofold The first was to find out if reproduction and lactation suffered from the inclusion of large amounts of nickel in the diet, and the second was to determine whether nickel retained in the body could be transferred by the mother to her offspring

The rats kept for reproduction studies had been receiving nickel-containing diets for eight weeks previously The same diets were continued so long as the rats were under observation throughout the period of gestation and lactation Thus all these rats were being fed nickel-containing diets continuously for three to four months or more The control rats were kept for corresponding periods on nickel-free diets

Immediately after the young ones were born, two from each litter were weighed and

TABLE V — DISTRIBUTION OF NICKEL IN TISSUE

All the figures are for 100 gm of fresh tissue weight

GROUP NO & NO OF Ni/100 GM DIET	BONES mg	LIVER mg	KIDNEY mg	SPLEEN mg	HEART mg	INTESTINE mg	TESTES mg	BLOOD mg	SKIN mg
Nickel Carbonate									
I — 100	35 85 34 69	1 11 1 30	4 31 3 37	2 86 3 31	5 01 4 00	2 54 2 56	1 86 2 68	3 10 2 11	1 25 0 71
II — 50	28 89 22 88	1 32 0 43	1 15 3 06	2 82 3 36	2 03 1 24	2 18 1 60	5 89 0 59	1 01 1 30	0 84 0 86
III — 25	18 76 13 52	0 10 0 15	1 19 1 00	0 55 0 26	0 79 0 76	1 84 0 69	1 32 2 33	0 48 0 34	0 24 0 10
Nickel Soaps									
I — 100	25 30 21 82	1 31 1 15	3 48 2 98	4 84 3 22	1 69 2 50	1 95 1 40	1 80 nil	1 06 1 17	0 78 0 78
II — 50	8 22 8 46	0 98 1 16	2 39 2 71	1 47 2 46	1 73 2 90	1 19 1 18	0 71 0 36	0 84 1 21	0 57 0 53
III — 25	3 60 5 33	0 42 0 57	1 44 2 02	0 92 1 65	0 88 0 91	0 64 0 74	nil nil	0 21 0 54	0 11 0 43
Nickel Catalyst									
IV — 100	14 73 17 56	0 89 1 27	2 55 2 37	3 47 1 85	1 79 2 29	1 08 1 28	0 22 0 65	0 81 1 00	0 56 0 65
V — 50	7 97 9 42	0 64 0 87	1 00 1 72	1 21 0 99	1 48 1 67	0 74 0 83	0 83 0 79	0 39 0 48	0 37 0 27
VI — 25	3 00 3 99	0 48 0 37	1 00 0 58	nil nil	1 03 0 63	0 51 0 34	0 92 nil	0 45 0 48	0 23 0 31
Control	nil nil	nil nil	nil nil	nil nil	nil nil	nil nil	nil nil	nil nil	nil nil

killed. The amount of nickel in the whole body was then determined The results of these estimations are given in Table VI

Experiments on Monkeys

Adult monkeys (*Macacus sinicus*) were fed on nickel-containing diets to confirm some of the findings obtained in rats with a different species of animals The basal diet consisted of a mixture of 75 parts of whole wheat and 25 parts of Bengal gram (without husk) ground to flour Nickel carbonate, nickel soaps of mixed fatty acids of groundnut oil and nickel catalyst were mixed with the combined flour to give 100, 50 and 25 mg nickel respectively per 100 gm of mixture The prepared flour was made into chapatis and offered to the monkeys with small quantities of carrot and cabbage The quantity of food given per monkey per day was 100 gm In addition, small amounts of vitamin A and D were given orally per week It was possible to use only 14 monkeys for this experiment, their distribution is shown in Table VII.

TABLE VI — NICKEL IN THE BODIES OF NEW-BORN RATS

GROUP NO & MG OF Ni/100 GM DIET	NO OF YOUNG ONES IN LITTER	WEIGHT OF YOUNG ONES, gm	NICKEL, MG./100 GM BODY WEIGHT
$NiCO_3$			
I — 100	3	4 5	2 21
		4 3	3 00
	5	4 2	2 19
		4 3	2 78
II — 50	9	4 7	1 70
		4 7	1 37
	6	4 0	1 24
		3 7	1 62
III — 25	5	4 1	nil
		3 9	nil
	6	4 8	nil
		4 6	nil
Control	8	3 1	nil
		3 9	nil
	10	4 0	nil
		4 3	nil
Nickel Soap			
I — 100	6	3 7	nil
		3 6	nil
	4	4 0	0 12
		4 1	0 18
II — 50	5	4 4	nil
		4 5	nil
	7	3 9	nil
		3 9	nil
III — 25	5	4 7	nil
		4 9	nil
	5	4 3	nil
		4 4	nil
Nickel Catalyst			
IV — 100	5	4 6	0 44
		4 6	0 33
	7	4 2	0 12
		4 3	0 15
V — 50	8	4 2	nil
		4 2	nil
	8	4 5	nil
		4 5	nil
VI — 25	7	3 9	nil
		4 0	nil
	8	4 3	nil
		4 3	nil
Control	9	4 9	nil
		5 0	nil

TABLE VII — DISTRIBUTION OF MONKEYS ON NICKEL-CONTAINING DIETS

LEVEL OF Ni, MG /100 GM FOOD	DIETS CONTAINING		
	NICKEL CARBONATE	NICKEL SOAP	NICKEL CATALYST
	No. of animals		
100	2		
50	2	2	2
25	2	2	
Nil	Two animals served as controls		

The feeding was continued for twenty-four weeks and weights were recorded weekly. As all the monkeys were adults, maintenance of weight together with the general behaviour and other manifestations of toxicity were used as criteria for the ill effects of nickel feeding

During the experiment two monkeys died, one from the nickel soap group (23rd week) and one control animal (soon after 24 weeks were over) Post-mortem examination did not reveal the cause of death. Blood of the animals was examined only at the termination of the experiment The initial and final weights of the monkeys and the results of blood examination are given in Table VIII All the monkeys appeared in excellent health as judged by their alertness and general behaviour It will be clear that with the exception of one monkey who lost 0 5 lb during six months, all others have maintained weight or showed a slight increase. Even in the two monkeys which died suddenly for no detectable reason, the weight had been steady till the week before death when last weights were taken So far as blood was concerned, nickel feeding did not appear to have any ill effects The various values given in columns 5 to 7 in Table VIII fall within the range for normal monkeys of the same species reported by Rao and Rao[15].

Summary

In view of the possibility of contamination with nickel of hydrogenated oils used for human consumption, experiments were undertaken to test the toxicity of nickel.

Albino rats and monkeys were used as experimental animals. Nickel carbonate,

TABLE VIII — BODY WEIGHTS & BLOOD FINDINGS IN MONKEYS KEPT ON NICKEL-CONTAINING DIETS

GROUP NO & MG OF Ni/100 GM DIET	SERIAL NO. OF MONKEYS	WEIGHT IN LB		BLOOD FINDINGS AT 6 MONTHS		
		Initial	At 24 weeks	R B C mill/c.m m	Haemoglobin gm /100 c c	W B C per c.m.m.
Nickel Carbonate						
I — 100	1	6 00	6 50	6 50	14 4	19,200
	2	6 25	7 25	6 93	12 7	16,800
II — 50	3	7 25	8 75	6 17	14 4	
	4	6 50	7 25	6 90	16 6	12,200
III — 25	5	5 25	6 50	6 92	13 9	18,200
	6	5 25	6 50	6 25	13 6	14,800
Nickel Soap						
II — 50	7	6 00	6 00	6 53	16 9	18,200
	8	5 75	Died after 22 weeks (wt. 5 5)			
III — 25	9	4 50	4 00	7 06	14 4	17,000
	10	5 25	5 25	6 51	14 8	20,400
Nickel Catalyst						
II — 50	11	4 50	5 25	6 68	13 6	15,650
	12	5 75	6 50	5 27	12 7	17,600
Control	C1	4 50	4 50	7 50	13 9	16,250
	C2	4 25	5 00			

nickel soaps of mixed fatty acids prepared from refined groundnut oil and nickel catalyst suspended in oil and supported on kieselguhr were used as test materials The dosage was fixed at three levels, viz 100, 50 and 25 mg nickel per 100 gm of an adequate ration

In rat experiments, growth, reproduction performance, metabolism of nickel, nickel content of tissues and of the offspring were studied

In experiments on adult monkeys, maintenance of weight, effect on health and on blood picture were observed, during and after continuous feeding for six months on nickel-containing diets

Results of Rat Experiments — (1) There were no significant differences in the growth rate (over eight weeks) of rats on nickel-containing diets as compared with that of control animals The reproduction performance was also similar in the respective groups The general condition of the surviving rats, fed on nickel diets for three to four months, was indistinguishable from that of the controls

(2) The retention of nickel from the three nickel preparations tested was found to be highest on nickel carbonate No appreciable difference between the other two groups were observed

(a) Approximately 71 to 91 per cent of ingested nickel was found in the faeces. On nickel soap and catalyst, the average faecal nickel amounted to 87·9 and 89·9 per cent respectively, whereas on nickel carbonate it was distinctly lower, i e 74 4 per cent

(b) The percentage of ingested nickel excreted in urine also varied with the nickel preparation , with nickel carbonate 1 56 per cent, with nickel soaps 1 21 per cent and with nickel catalyst 0 77 per cent

(c) Within each group, the level of nickel intake did not make any appreciable difference in the proportions excreted in faeces and urine respectively

(3) On the three nickel diets, appreciable amounts of nickel were found in the tissues As arranged in order of decreasing nickel content, they would be, bone, spleen, kidney, heart, intestine, blood and testes The nickel content of tissues of rats on nickel carbonate was higher than in the other two groups for corresponding levels of nickel intake

(4) At the highest level of intake, i e, 100 mg per 100 gm ration, nickel was found in the body of one-day old young ones Those born of mothers on nickel carbonate showed the highest nickel content. At 25 mg per 100 gm ration, no nickel could be detected in the bodies of the young ones from mothers in all the three groups

The work carried out thus far shows that on the comparatively high doses of nickel tested in rats, no toxic symptoms could be elicited even after three to four months of continuous feeding

Results of Monkey Experiments — At the levels of nickel intake tested over a period of six months, adult monkeys maintained their weight and at the end were in perfect health The haemoglobin, R B C and W B C. counts of blood were normal in monkeys fed on nickel-containing diets

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Letters to the Editor

A SIMPLE FLOTATION CELL

A simple laboratory flotation cell of the agitation type has been constructed (Fig. 1) A can 3 5" × 3·5" open at both ends and with perforated walls serves as the agitation chamber In the bottom portion of the can, inverted V-shaped slots were cut for aiding circulation of the pulp between this chamber and the rest of the cell An enamelled cup, 6 5" dia. × 3" height, was used as the cell proper in which the perforated can was centrally held by suitable stays The above assembly was placed in an aluminium basin, 10" dia × 2 5" height, so that the froth from the cell overflows directly into it A propeller type of stirrer worked in the direction required to produce a vertical draft in the central cell, in this case a Mitchell laboratory stirrer coupled with a universal motor, was placed in the agitation chamber slightly above the bottom

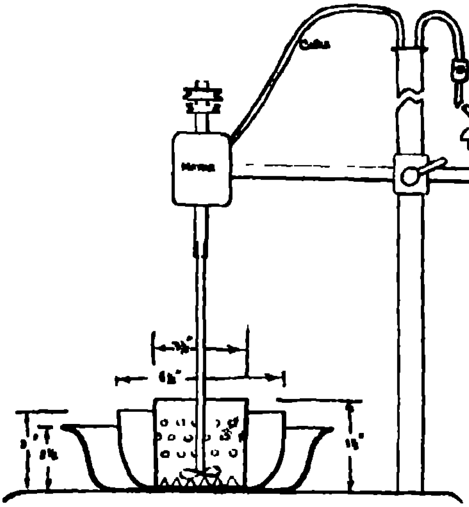

Fig 1

The cell was first half filled with water, and then necessary chemicals (not frother) were added into the agitation chamber and stirring started Frother was added after a few minutes and more water added till the level of the latter was raised to about half inch below the rim of the cell The speed of the stirrer was also increased suitably

The cell has been tested for the flotation of galena and found satisfactory. It differs from the standard types in having an annular *spitzkasten* with a large " quiet zone ". This is an additional advantage, the froth area being large, the entangled gangue in the froth drains off better resulting in a better grade of concentrate

The author's thanks are due to Principal R P Sinha and Prof S. K. Bose for their interest.

K. K Majumdar

Indian School of Mines &
Applied Geology
Dhanbad
September 26, 1949

INVESTIGATIONS ON FAMINE RATIONS: *PANEVAR* (*CASSIA TORA* LINN.) SEED, A PROTEIN-RICH FEED FOR LIVESTOCK

Cassia tora Linn, commonly known as *chakunda* (Hindi), *Panevar* (Bengali), *panwar*, *pawar* (Punjab, N W F), *tantemu* (Telugu), *tagarai* (Tamil), and *tankli* (Marathi), grows in a wild state throughout India, Ceylon and the tropics in general About 3 to 4 weeks after the monsoon sets in, the plant makes its appearance and soon covers most of the other growths In green condition, neither the leaves nor the pods are ordinarily taken by animals. We were interested to find out if this plant, which grows so abundantly all over the country and is considered a pest, could be utilized as a cattle feed

In previous investigations, the use of materials like mango seed kernel[1] *jaman* seed[2], tamarind seed[3], and *Saccherum spontaneum*[4], which were hitherto considered as waste, have been described This note deals with the observations on *panevar* (*Cassia tora* Linn) seed.

The chemical composition of *panevar* seed is given in Table I. In this table we have also included the data on some of the commonly used concentrates for comparison

It will be observed that it compares favourably with gram in protein content and is definitely richer than the other cereals The calcium and phosphorus contents of the seeds are definitely higher as compared to the other seeds Unlike the other concentrates and cereals, the calcium phosphorus ratio is very well balanced in these seeds, an important factor in the metabolism of calcium and phosphorus

As regards the palatability of the *panevar* seeds, they are not relished ordinarily in the green condition But when the seeds are thoroughly dried in the sun for 15 to 20 days, and then gradually introduced into the ration, the animals develop a taste and in about 15 days, 50 per cent of the concentrate can be replaced by these seeds

To evaluate the nutritive value of *panevar* seeds, *Kumauni* bullocks were used as experimental animals, and were fed half a pound rape cake plus half a pound crushed *panevar* seeds and 8 lb of wheat *bhoosa* In addition to this ration an ounce of salt was also fed This ration was fed to the animals for a period of about four months During the last 10 days of the observation, the digestibility trial was carried out according to the usual procedure adopted in these laboratories

The mean digestibility coefficients recorded for crude protein, ether extract, and total carbohydrates are 79, 88 and 43 respectively and the digestible nutrients per 100 lb of dry seeds are 16 64 lb crude protein, 6 83 lb of ether extract, 27 41 lb of total carbohydrates, and 59 4 lb of total digestible nutrients The animals exhibited a positive balance for nitrogen, calcium and phosphorus

During the period of observation the animals maintained good health and no untoward clinical symptoms were noticed as was evident from the analysis of the blood of these animals.

TABLE I — CHEMICAL COMPOSITION OF *PANEVAR* SEED & SOME COMMON FEED CONCENTRATES

	Crude protein	Ether extract	Crude fibre	N F E.	Total ash	CaO	P_2O_5
Panevar seed	21 12	7 75	13 16	51 34	6 63	1 22	1 62
Gram	21 53	3 08	9 72	62 09	3 48		
Barley	11 50	1 06	5 39	78 84	3 21	0 08	0 33
Oats	10 07	6 55	12 71	65 88	4 79	0 16	0 93
Maize	11 11	4 39	1 90	80 66	1 94	0 02	0 94
Cotton seed	18 02	20 60	25 74	30 98	4 66		
Babul seed (crushed)	14 64	3 26	14 80	59 87	7 43		

A detailed article will be published elsewhere.

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THERMAL SPRINGS NEAR GANGNANI, TEHRI-GARHWAL HIMALAYAS

The author recently studied these springs, which occur in the Tehri-Garhwal Himalayas, while investigating the Tehri-Gangotri region Very little is known about these springs. The only reference to one of the springs occurs in Dr T Oldham's account[1] where it is mentioned under the name Huri and is stated to occur "on the left bank of the Bhagirathi river, about quarter of a mile south of village"

The first hot spring issues above the left bank of the Bhagirathi, a little before the suspension bridge at Gangnani This spring is known as Rishi Kund (30° 54′ 15″ 78° 40′ 52″) and is marked between contours 6,200′ and 6,400′ on the Forest Map No 12 covering part of sheet 53J/N E The spring is 73 miles from Tehri Where the spring issues forth a small temple has been built The discharge is quite copious and is made to flow into three tanks Where the water flows out, a calcareous tufaceous deposit has been laid which becomes compact and banded in places. A thin section of the compact banded calcareous deposit is seen to consist of bands of elongated crystals of calcite running almost parallel to each other A band is seen to be composed of a mosaic of crystals of calcite. Yellowish iron stains are observed in places, while occasionally a speck of haematite also occurs.

The temperature of the spring is fairly high and it was noted by Dr Oldham as 139·8°F The water in all probability is radioactive The hot spring evidently represents the decadent phase of igneous activity in the region Sulphuretted hydrogen is noticed and there is taste of sulphur in the water also The rocks of the neighbourhood mostly comprise garnetiferous biotite schists with some associated gneisses

Another hot spring issues forth near the left bank of the Bhagirathi, only slightly above the bed of the river, 2 5 miles almost due north of Rishi Kund It is located just below the Joti (camping ground) marked on sheet 53J/N E The flow is fairly copious, but the temperature is not so high as that of Rishi Kund

A third hot spring occurs above the left bank of the Bhagirathi about half a mile below the confluence of the Lod Gad with the Bhagirathi The sides of the gorge are formed of practically vertical cliffs, about a thousand feet in height, and water is seen issuing forth at some height above the bed of the river and a characteristic tufaceous deposit, similar to that of Gangnani, is clearly seen

It is noteworthy that these three springs occur within about 3 5 miles above the left bank of the Bhagirathi and the rocks here are traversed by a fault along which these juvenile waters containing carbonate of lime and a little iron in solution ascend on to the surface

Up to Tehri there is a bus service which might be extended on to Dharasu, a distance of another 28 miles Beyond Dharasu one has either to march a distance of 45 miles or a pony could be the only transport

H L Chhibber

Banaras Hindu University

December 5, 1949

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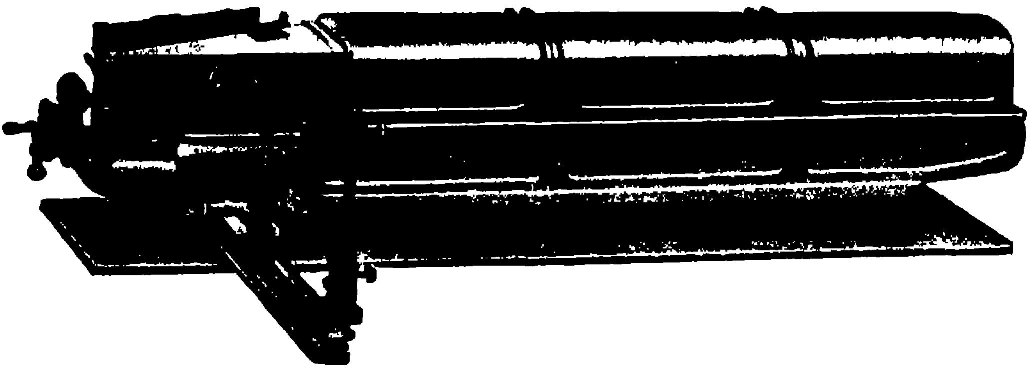

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The Alkaloids of Indian *Stephanias* : Part I
Isolation of Three Crystalline Alkaloids from the Tubers of *Stephania glabra* Miers

GOVIND RAI CHAUDHRY & SALIMUZZAMAN SIDDIQUI
Chemical Laboratories, C S I R , Delhi

Three crystalline alkaloids provisionally named as gindarine, $C_{21}H_{25}O_4N$, gindarinine, $C_{17}H_9H(OCH_3)_4HNO$, and gindaricine, $C_{18}H_{19}O_3N$, have been isolated from the tubers of *Stephania glabra* Gindarinine possesses antibiotic activity in contrast to gindarine which is inactive

AMONGST the *Stephania* species (N O *Menispermacea*), *Stephania glabra*, *Stephania herandifolia*, *Stephania elegans* and *Stephania gracilenta* grow plentifully in India They are all climbing shrubs which grow at altitudes of 3,000′ to 8,000′ above the sea level in the Himalayas, Khasi Hills in Assam and other hilly tracts throughout the country There is a great deal of confusion in regard to the identity of the first two species, namely *Stephania glabra* and *Stephania herandifolia*, as the various parts of the two plants are alike except for slight variations in the leaf lamina, according to a private communication from Dr S N Bal of Botanical Survey of India Osmaston[1] as well as Parker[2] have mentioned that *Stephania glabra* possesses round tubers, but they have not noted this characteristic for either *Stephania elegans* or *Stephania gracilenta* In view of the promising results obtained with one of the alkaloids, cepharanthine, isolated from *Stephania cepharantha* and *Stephania sasakii*, in the treatment of tuberculosis and leprosy as noted by Buchi[3], and in view also to the lack of any reference in literature on the chemistry of the Indian *Stephanias*, the present investigation on *Stephania glabra* was undertaken as a part of a general study of the alkaloids of the *Stephania* species

Stephania glabra Miers (Hindi, *gindaru*) is a large, climbing shrub with greenish-yellow flowers and large tubers, sometimes a single tuber weighing up to 30 kg Roxburgh[4] states that the acrid root is useful in the treatment of pulmonary tuberculosis, asthma, dysentery, fevers and intestinal complaints It is also widely used by the hilly tribes for these ailments As a result of the present investigations, the following alkaloids have been isolated in a crystalline form from the tubers

1 Gindarine, $C_{21}H_{25}O_4N$ $[C_{17}H_{13}N(OCH_3)_4]$, m p , 147°C $[\alpha]_D^{18°} = -26\ 1°$ in chloroform , isolated also in the form of its naturally occurring nitrate , yield 1 5 per cent on the weight of the air-dried powdered tuber

2 Gindarinine nitrate isolated in the form of its naturally occurring nitrate salt conforming to the formula $C_{17}H_9N(OCH_3)_4MNO_3$ Yield, 1 2 per cent on the weight of the air-dried powdered tuber

3 Gindaricine, $C_{18}H_{19}O_3N$, $C_{16}H_{13}ON(OCH_3)_2$, m p , 193°C , $[\alpha]_D^{40°} = +137\ 0°$ in alcoholic solution Yield, 0 12 per cent on the weight of air-dried powdered tuber

A crystallizate consisting of the naturally occurring nitrates of gindarine and gindarinine was obtained directly from the alcoholic extracts of the tubers on concentration under reduced pressure, removal of the fatty matter, and cooling the concentrate after addition of ether and petroleum ether or dilution with water The crude crystallizate, on repeated fractional crystallizations from methanol, finally gave gindarine nitrate melting at 222°C from the less soluble fractions and gindarinine nitrate melting at 248°C from the tail fractions During the course of a number of workings, it was noted that whereas the extracts of fresh tubers yielded a crude crystallizate consisting of almost exclusively of gindarine nitrate, the air-dried tubers gave mainly the gindarinine salt The filtrate from the initial crystallizate of the alkaloidal salts yielded a further quantity of gindarine, either as free base on basification with ammonia, or as its sparingly soluble iodide on treatment of the solution with potassium iodide The final filtrate from either of these operations gave the bismuth iodide double salt on treatment with bismuth iodide in acidic medium The double salt gave gindaricine on decomposition with ammonia and working up in the manner described in the experimental Alternatively, gindaricine could also be isolated from the final filtrates through treatment with strong caustic alkali and extraction with ethyl acetate in nearly the same yield as obtained through the bismuth iodide double salt

Gindarine is a mono-acidic base and yields well-defined crystalline salts The naturally occurring salt of the base has been shown to be the nitrate through comparison with the salt directly prepared from the base It contains four methoxyl groups, which account for all the oxygen atoms present in the base, and does not contain any N-CH_3 group or active hydrogen It could not be acetylated or benzoylated and failed to react with nitrous acid, which would indicate the base to be tertiary in character With excess of methyl iodide in chloroform solution, the base gave a mono-methiodide Gindarine could not be reduced either with tin and hydrochloric acid or catalytically with platinum black The methoxyl value obtained in the case of gindarine is 3 per cent lower (found 31 9, required 35 0 per cent) but agreed well in the cases of both its nitrate and methiodide, the difference in the methoxyl value per group being only 0 25 per cent (found in nitrate 27 6, required 28 7 per cent, found in methiodide, 23 8, required 24 9 per cent)

Due to the strongly basic character of gindarinine, it could not be liberated from its salts with ammonia or caustic soda in the usual manner Treatment of gindarinine nitrate with strong alcoholic alkali gave a crystalline base in the form of colourless needles melting at 141°C which rapidly coloured on exposure to air or on crystallization from solvents, and could not be sufficiently purified for analysis This base could, however, be converted back to the original nitrate on treatment with dilute nitric acid It was further characterized through its various crystalline salts It contains four methoxyl groups which account for all the oxygen atoms present in it

Gindaricine yields well-defined crystalline salts, and contains two methoxyl groups which account for two out of the three oxygen atoms present in the molecule Preliminary experiments kindly carried out by Mrs Osborn at the Sir William Dunn School of Pathology, Oxford, show that gindarinine nitrate possesses definite antibiotic action against staphylococcus Results of further studies in the constitution of these bases will be dealt with in a subsequent communication

Experimental

Isolation of Gindarine & Gindaricine from the Fresh Tubers — 3 kg of finely minced fresh tubers were repeatedly percolated with alcohol at the room temperature for about 10 days The combined percolates were concentrated under reduced pressure, and the dark greenish-yellow syrupy concentrate was repeatedly extracted with ether to remove the fatty matter The ether-insoluble residue was diluted with water and kept in the cold when a large crop of crystals of the naturally occurring salt of gindarine (6 9 gm) contaminated with darkish resinous matter separated out On concentration of the combined mother liquors, a second crop of crystals was obtained, but much of the alkaloid remained in the solution and was precipitated out as its crystalline iodide by treatment with potassium iodide after acidification with acetic acid (5 0 gm) In another working, the base was precipitated out from the mother liquors of the gindarine natural salt with ammonia but the separation of gindarine was more complete through the iodide, as it is less soluble in water than the free base The crude base liberated from the iodide with ammonia was dissolved in alcohol and treated with ether and petroleum ether to remove resinous impurities The clear reddish-yellow filtrate was concentrated and kept in the cold, when crude gindarine crystallized out in the form of greenish hexagonal plates and prismatic rods melting at 142°C The crude base was repeatedly crystallized from a mixture of alcohol, ether and petroleum ether, and finally from acetone, when pure gindarine was obtained in the form of rectangular hexagonal prismatic plates and prismatic rods which have slightly greenish tinge but give a colourless powder melting at 147°C

The final filtrate from the precipitate of iodide, obtained above, was acidified with dilute hydrochloric acid and treated with a concentrated solution of bismuth iodide The yellowish-orange micro-crystalline precipitate of the bismuth iodide double salt was filtered and washed with acidulated water The double salt was macerated with 50 per cent aqueous potassium hydroxide and extracted with ethyl acetate The ethyl acetate solution was washed with a small quantity of ice-cold water, dried over anhydrous sodium sulphate, concentrated on the water bath to a small volume and kept in the cold, when crude gindaricine was obtained in the form of prismatic rods melting at 175°C The crude base thus obtained was purified through the sparingly soluble iodide, repeated crystallization of the iodide from water (norit), liberation of the base from the pure iodide and subsequent repeated crystallization from benzene, when it was finally obtained in the form of colourless silky needles melting at 193°C

Isolation of Gindarine, Gindarinine Nitrate & Gindaricine from the Air-dried Tubers — 8·5 kg of air-dried, finely powdered tubers were repeatedly percolated with alcohol, and the syrupy concentrate obtained on removal of the solvent *in vacuo* was worked up in a similar manner as adopted in the case of the fresh tuber The initial crystallizate (104 gm) in this working was found to consist of a mixture of the naturally occurring salts of gindarine (30 gm) and gindarinine (74 gm) which were separated from each other through repeated fractional crystallization from dilute methanol The combined mother liquors were treated with ammonia when a further quantity of crude gindarine was obtained as the free base (80 gm) The final filtrate and washings were basified with 30 per cent sodium hydroxide and the base extracted out with ether At this stage a part of gindaricine crystallized out forming a middle layer between the ethereal layer and the alkaline layer The crystals were filtered and washed with cold water (6·5 gm) The ethereal layer was washed with a small quantity of water, dried over anhydrous sodium sulphate and concentrated on the water bath The concentrate yielded a second crop of crystals (4·5 gm) of gindaricine The total yield of gindaricine after purification carried out as in the case of the crude base from the fresh tubers was 10 gm (0·12 per cent on the weight of the air-dried powdered tuber)

Characterization of Gindarine — Gindarine is sparingly soluble in petroleum ether and ether, soluble in acetone and ethyl acetate in the hot and more readily in methanol and alcohol It crystallizes from these solvents in the form of colourless rectangular or hexagonal prismatic plates and prismatic rods melting at 147°C, the form of crystals mainly depending upon the solubility of the base in the particular solvent and conditions of crystallization On slow crystallization from alcohol, it forms prismatic hexagonal plates with a slightly greenish tinge It shows $[\alpha]_D^{28^\circ} = +26·1^\circ$ in chloroform solution It does not give any colouration with ferric chloride in alcoholic solution Comparative colour reactions of gindarine and gindaricine are noted in Table I Found, C, 70·9, H, 7·1, N, 4·0, N-CH_3 (Herzig and Meyer), nil, OCH_3 (Zeissel), 31·9 per cent M W (cryoscopic in benzol), 340, $C_{21}H_{25}O_4N$ requires C, 70·9, H, 7·0, N, 4·0, OCH_3 (for 4 methoxyls), 35·0 per cent, M W 355

TABLE I — COLOUR REACTIONS OF GINDARINE & GINDARICINE

REAGENTS	GINDARINE	GINDARICINE
1 Conc H_2SO_4	No colour, pink colour on heating	Colourless changing to light yellow and no change on treating and dilution with water
2 Conc H_2SO_4 $KClO_3$	Yellow to golden yellow	Brownish yellow fades on keeping
3 Conc HNO_3	Golden yellow	Golden yellow
4 Erdmann's reagent	Light yellow no change on heating or dilution	Yellowish green changing to bluish green on warming to deep blue and on dilution changes to violet and finally to purple
5 Frohde's reagent	Yellow changing to light green	Steel grey changing to deep bluish green, on heating to marine blue, and on dilution to dirty green changing to brownish yellow

The naturally occurring gindarine salt after repeated crystallization of the initial crystallizate from dilute alcohol was finally obtained in the form of slightly greenish yellow hexagonal plates and prismatic rods, m p 222°C (decomp) Found C, 60 3, H, 6 1, N, 6 7, OCH_3 (Zeissel) 27 6, $C_{21}H_{25}O_4N$ HNO_3 requires C, 60 4, H, 6 1, N, 6 9, OCH_3 (for 4 methoxyls), 28 7 per cent The salt did not give any depression in melting point with gindarine nitrate prepared by the addition of potassium nitrate to a solution of the base in dilute acetic acid The nitrate is readily soluble in dilute methanol or alcohol, fairly so in acetone and ethyl acetate in the hot, sparingly soluble in water and insoluble in ether or petroleum ether

The hydrochloride was prepared by the addition of ethereal hydrochloric acid to an alcoholic solution of the base, when it came out as a snow-white flocculent precipitate The precipitation was completed by the addition of ether On crystallization from hot alcohol it formed colourless needles and prismatic rods melting at 245°C (decomp) It is fairly soluble in alcohol and in water in the hot, insoluble in ether or petroleum ether The hydrochloride is also polymorphous in character like the base, the form of the crystals depending on the nature of the solvent and conditions of crystallization Found Cl, 9 3, $C_{21}H_{25}O_4N$ HCl requires Cl, 9 1 per cent

The hydroiodide, obtained by the addition of potassium iodide to a solution of the base in acetic acid, was crystallized from hot dilute acetic acid, when it came out as colourless rods and plates melting at 228°C (decomp) It is fairly soluble in hot alcohol, very sparingly so in water

The hydrobromide separated out in the form of colourless rectangular plates on cooling a solution of the base in 1 per cent hydrobromic acid It begins to darken in colour from 232°C and melts with decomposition at 240°C It is readily soluble in alcohol or methanol in the hot, sparingly so in water and insoluble in ether or petroleum ether

The picrate was obtained by the addition of aqueous picric acid to an aqueous solution of gindarine hydrochloride as a brilliant yellow flocculent precipitate, which crystallized from dilute alcohol in bright-yellow silky needles melting at 188°C (decomp)

The chloroplatinate was obtained on addition of an aqueous solution of platinic chloride to a solution of the hydrochloride in 2 per cent hydrochloric acid, as a golden yellow flocculent precipitate which, when washed with water and dried on a porous plate, formed a light orange-yellow crystalline powder melting with decomposition at 212°C It is sparingly soluble in water, insoluble in alcohol and acetone even in the hot Found Pt, 17 7, $(C_{21}H_{25}O_4N)_2$ H_2PtCl_6 requires Pt, 17 5 per cent

The sulphate was obtained in the form of colourless hexagonal plates by the addition of ether to a solution of the base in alcoholic sulphuric acid It is exceedingly soluble in water and alcohol, m p, 218°C (decomp)

The methiodide was obtained by treating 1 0 gm of gindarine in dry chloroform solution with 3 c c of methyl iodide in the same solvent, and leaving the reaction mixture overnight at the room temperature The methiodide precipitated out as a colourless crystalline powder on addition of ether to the reaction mixture On crystallization from a mixture of chloroform, acetone and ether, it was obtained as colourless prismatic rods melting at 248°-49°C (decomp) It is easily soluble in chloroform, alcohol, acetone and in water in the hot Found C, 52 4, H, 5 6, N, 2 5, OCH_3 (Zeissel) 23 8, N-CH_3 (Herzig and Meyer) 5 8, I, 26 2, $C_{21}H_{25}O_4N$ CH_3I requires C, 53 1, H, 5 5, N, 2 8, OCH_3 (for 4 methoxyls), 24 9, N-CH_3 (for 1), 5 8, I, 26 1 per cent

Characterization of Gindaricine — Gindaricine forms colourless silky needles melting at 193°C (decomp) $[\alpha]_D^{41^\circ} = +137\ 0^\circ$ in alcoholic solution It is readily soluble in alcohol, chloroform, acetone and ethyl acetate, fairly soluble in benzene, sparingly so in ether, petroleum ether and water It crystallizes from benzene in aggregates of prismatic rods and clusters of needles It gives a dark-blue colouration with ferric chloride in alcoholic solution Found C, 72 6, H, 6 4, N, 4 6, OCH_3 (Zeissel) 18 8, N-CH_3 (Herzig and Meyer) nil, $C_{18}H_{19}O_3N$ requires C, 72 7, H, 6 3, N, 4 7, OCH_3 (for 2 methoxyls), 20 8 per cent

The hydrochloride was prepared by the addition of ethereal hydrochloric acid to a solution of the base in absolute alcohol, when it came out as a snow-white silky crystalline mass in the form of scattered prismatic rods and needles On crystallization from alcohol it formed colourless silky needles melting at 232°C It is readily soluble in water, sparingly so in alcohol in the cold, and fairly soluble in the hot Found Cl, 10·7, $C_{18}H_{19}O_4N$ HCl requires Cl, 10 7 per cent

The picrate was obtained as bright-yellow prismatic rods and plates on the addition of ethereal picric acid to an alcoholic solution of the base It is easily soluble in alcohol, and water in the hot and sparingly so in the cold It melts with decomposition at 150°C

The chloroplatinate was obtained as a cream-yellow flocculent precipitate on the addition of platinic chloride to a well-cooled solution of the hydrochloride in water On keeping for some time it turned crystalline (star-like aggregates) It is appreciably soluble in hot water, and insoluble in alcohol It melts with decomposition at 230°C Found Pt, 19 3, $(C_{18}H_{19}O_3N)_2\ H_2PtCl_6$ requires Pt, 19 4 per cent

Characterization of Gindarinine Nitrate — After repeated crystallization from dilute methanol, pure gindarinine nitrate was obtained in the form of lemon-yellow needles melting at 248°C (decomp) It is readily soluble in alcohol, methanol and water in the hot and insoluble in ethyl acetate, ether and petroleum ether Found C, 60 3, 60 4, H, 5 5, N, 6 2, OCH_3 (Zeissel), 29 4, $N\text{-}CH_3$ (Herzig and Meyer), nil, ($_{21}H_{22}N_2O_7$ requires C, 60 8, H, 5 3, N, 6 7, OCH_3 (for 4 methoxyls), 30 0 per cent

The hydrochloride was obtained as orange-yellow needles on the addition of concentrated hydrochloric acid to an aqueous solution of gindarinine nitrate On crystallization from dilute methanol, it formed clusters of orange-coloured needles and prismatic rods melting at 215°C with decomposition It is readily soluble in alcohol, methanol and in water in the hot, and insoluble in ether or petroleum ether

The hydroiodide was prepared by the addition of potassium iodide to a solution of gindarinine nitrate in acetic acid On crystallization from dilute alcohol it formed golden-yellow silky needles, which sintered at 220°C, softened at 235°C and melted with decomposition at 245°C It is fairly soluble in alcohol, acetone and water, and readily soluble in aqueous acetone, dilute alcohol and methanol

The picrate was obtained by the addition of aqueous picric acid to a dilute alcoholic solution of gindarinine hydrochloride as a brilliant lemon-yellow crystalline mass, which crystallized from alcohol in lemon-yellow needles melting at 220°C (decomp)

The chloroplatinate was obtained as a cream-yellow crystalline mass on the addition of an aqueous platinic chloride to a well-cooled solution of gindarinine hydrochloride in dilute hydrochloric acid It is soluble in alcohol, and water in the hot, and melts with decomposition at 276°C

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Studies in the Conessine Series: Part 10 — Action of Fuming Nitric Acid on Conessine

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The base obtained from conessine by the action of ice-cold fuming nitric acid may be represented as $C_{21}H_{31}N_2O_4N(CH_3)_2$, corresponding to dihydro-apoconessine-nitrosate. The change is brought about by the splitting of the ring nitrogen atom along with its N-methyl, and subsequent formation of the nitrosate.

FROM the results of previous studies[1] on the action of concentrated sulphuric acid, nitric acid, potassium permanganate, chromic acid and bromine on conessine, Siddiqui and co-workers showed that the carbocyclic nucleus of conessine, suggested by Spaeth and Hromatka[2], to consist of condensed hydro-aromatic ring systems, was extremely resistant to the action of these reagents. On the other hand, pyrolysis of conessine-hydriodide carried out by Siddiqui and Sharma[3] yielded a hydrocarbon, conesen, $C_{21}H_{30}$, due to the thermal instability of the basic nitrogen atoms in the conessine molecule. For the same reason dehydrogenation of conessine is extremely difficult, and extremely low yields of basic products (0.3 per cent) are obtained. In regard to the results of dehydrogenation of conesen, we are in complete agreement with Haworth and co-workers[4] and due to the inexplicable difficulties encountered in the purification of the lower melting hydrocarbon as also noted by Haworth *et al.*, this line of attack was not pursued further by us. However, in order to obtain degradation bases of conessine with the nitrogen atoms intact, it was considered desirable to study the action of fuming nitric acid on conessine under more drastic conditions than hitherto employed, and the present communication deals with the results of these investigations.

When conessine is dissolved in ice-cold fuming nitric acid and the solution carefully evaporated on a watch glass over a water bath, a pale-yellow brittle powder is obtained which is soluble in water, ammonia or dilute caustic alkalies and gives, on concentration of its aqueous solution, a crystalline nitrate. The base liberated from the nitrate and a number of salts prepared from it are crystalline in character. The analytical data of the base are in agreement with the formula $C_{23}H_{37}N_3O_4$. It is saturated to bromine and does not give an immediate colouration with tetranitromethane in chloroform solution. The base contains one basic nitrogen and only two N-methyls as against two basic nitrogen atoms and three N-methyls present in the original base and may be represented as $C_{21}H_{31}N_2O_4\,N(CH_3)_2$, corresponding to dihydro-apoconessine-nitrosate. These changes have been, apparently, brought about by the splitting of the ring nitrogen atom along with its N-methyl and the subsequent formation of the nitrosate.

Experimental

1.5 gm conessine was dissolved in 5.0 c.c. of ice-cold Schering-Kahlbaums's fuming nitric acid (d. 1.48) on a watch glass and the solution was carefully evaporated to dryness on a boiling water bath. The pale-yellow brittle mass thus obtained (1.3 gm) was extracted with water several times till only a negligible amount of brownish resinous mass was left behind. The yellow-coloured aqueous solution, after concentration and keeping in the cold, gave a white crystalline mass, sparingly soluble in water, which, on recrystallization from the same solvent, yielded colourless, pentagonal plates melting at 235°C (decomp.), yield 0.35 gm. The mother liquors were made alkaline with caustic soda when a flesh-coloured precipitate, which yielded a small quantity of nitroconessine, was obtained.

In the course of attempts to increase the yield of the crystalline nitrate, it was noted that while repeated treatment of conessine in the above manner made little difference in the yields, slight changes in the density of nitric acid considerably lowered the yield of the nitrate The pure nitrate (m p 242°C decomp) obtained after a few crystallizations from water was dissolved in dilute acetic acid and the solution was made alkaline with ammonia The white precipitate obtained was filtered, washed with water and dried on the porous plate On crystallization of the dried base from methanol, it melted at 183°C

Dihydro-apoconessine-nitrosate, $C_{21}H_{31}N_2O_4\ N(CH_3)_2$ — The base is sparingly soluble in ether and petrol ether, fairly soluble in acetone and methanol in the hot and exceedingly soluble in chloroform It crystallizes from ethyl acetate or acetone in colourless rectangular plates Found C, 65 8, H, 9 2, N, 11 2, N-CH_3 (after Herzig and Meyer), 6 5, $C_{23}H_{37}N_3O_4$ requires C, 65 8, H, 8 8, N, 10 2, N-CH_3 (for 2 methyls), 7 1 per cent

It does not give any colouration with tetranitromethane in chloroform solution but develops a pale-yellow colour on keeping the solution for 10 min

The hydrochloride, prepared by the addition of ether to a solution of the base in alcoholic hydrochloric acid and subsequent crystallization of the precipitate from alcohol, acetone and ether mixture, came out in the form of colourless silky needles melting at 241°C (decomp) It is easily soluble in water, alcohol or methanol Found Cl, 8 1, $C_{23}H_{37}N_3O_4$ HCl requires Cl, 8 0 per cent

The hydriodide was obtained as a white crystalline precipitate on the addition of a concentrated potassium iodide solution to a solution of the base in dilute acetic acid On recrystallization from water, it is obtained as colourless rectangular plates melting at 259°C (decomp) Found I, 23 4, $C_{23}H_{37}N_3O_4$ HI requires I, 23 9 per cent

The chloroplatinate is obtained as a light-orange coloured precipitate when a solution of platinic chloride was added to an aqueous solution of the hydrochloride of the base It begins to darken from 235°C onwards and melts at 259°C with decomposition Found Pt, 16 1, $(C_{23}H_{37}N_3O_4)_2\ H_2PtCl_6$ requires Pt, 16 0 per cent

The picrate is obtained as a bright-yellow crystalline powder by the addition of aqueous picric acid to an aqueous solution of the hydrochloride of the base It shrinks at 156°C, sticks to the sides at 159°C and melts down at 159°C

The methobromide was prepared by the addition of ether to a solution of the base and methyl bromide in choloroform solution After recrystallization from alcohol, acetone and ether mixture, it was obtained in the form of colourless silky needles melting at 261°C (decomp) Found N-CH_3, 8 1, Br, 16 1, $C_{23}H_{37}N_3O_4\ CH_3Br$ requires N-CH_3 (for 3 methyls), 9 0, Br, 16 0 per cent

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Chemical Examination of Depolymerized Castor Oil Gel

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Depolymerization of castor oil gel at 350° to 370°C gives a dark viscous liquid containing unsaturated derivatives of mono- and dicarboxylic acids, aldehydes and hydrocarbons

WHEN castor oil is subjected to prolonged heat treatment in the presence or absence of dehydration catalysts, it undergoes a series of changes, ultimately resulting in an insoluble reddish-yellow gel No industrial uses existed for this material till Ranganathan and Siddiqui[1] recently developed a heat-treatment process for converting the gel into a soluble viscous liquid which could be utilized in the manufacture of varnishes, enamels, paints, adhesives, waterproofing compositions and like materials The present investigation was undertaken with a view to examine the nature of the constituents of this depolymerized liquid product

Bussy and Lecanu[2] observed that the gelatinous residue left over after the distillation of castor oil decomposes on further heating A study of the decomposition products of glycerides and of metallic and organic derivatives of vegetable oils have been made[3 4] employing temperatures ranging from 500° to 600°C or lower temperatures of the order of 200° to 300°C with or without the addition of catalysts In several of these cases it has been found[5] that the products of decomposition generally consist of hydrocarbons Rice and Murphy[6] have studied the pyrolysis of substituted cyclohexenic compounds and have shown that in some cases there is a rupture of the ring itself As the temperatures employed by Ranganathan and Siddiqui[1] were much lower than those used by previous workers, the chances of the rupture of the ring can be excluded

As the usual Twitchell's lead salt alcohol did not give a satisfactory separation of the products of depolymerization, distillation under reduced pressure and fractional precipitation methods have been adopted for the separation of various constituents

2 kg of castor oil gel was heated in a wide-mouthed, round-bottom flask in an air bath to 300°C No noticeable change was brought about in the gel even on prolonged heating at this temperature On raising the temperature to 350°C for about 15 to 30 min there was a sudden rise of temperature with evolution of vapours, and liquid patches formed on the surface of the gel At 370°C the entire gel was gradually transformed into a viscous liquid This process took about 2 hr, and the resultant product was a dark viscous liquid having the following characteristics

Refractive index (32°C)	1 493
Acid value	75 6
Saponification value	
½ hr heating	180 5
4 hr heating	198 2
Iodine value (Wijs)	67 9
Acetyl value	4
Diene value (Ellis and Jones)	nil
Water soluble acids	1%
Water insoluble acids	88%
Unsaponifiable matter	7 6%

1 *Oxidation Products* — The depolymerized material was treated with alkaline potassium permanganate by the modified Bertram's method The residue of oxidized acids was only partly soluble in petrol ether, the rest being soluble in ether sulphuric, the two fractions having the following characteristics

	Petrol ether soluble fraction	*Ether sulphuric soluble fraction*
Yield of oxidized acids, %	13 6	41 46
Iodine value (Wijs, 2 hr)	78 41	11 12
Saponification value (4 hr)	200 6	244 5
Saponification equivalent	270 1	229 1

2 *Isolation of Free Acids from Depolymerized Castor Oil Gel & Their Separation by Twitchell's Method* — 50 gm of the material was refluxed for 6 hr with excess of alcoholic potash The alcohol was distilled off and the soap dissolved in water The unsaponifiable matter was extracted with

ether, and the soap solution decomposed with dilute sulphuric acid in an atmosphere of nitrogen The fatty acids were extracted with ether and dried *in vacuo* at 100°C , yield 43 gm 40 gm of the acids were subjected to Twitchell's lead salt-alcohol process as described by Hilditch[7] A portion (A) of the lead salt was insoluble in hot alcohol and was separated from the soluble salts by decanting off the supernatant liquid and repeatedly digesting the residue with hot alcohol The combined alcoholic solution was cooled overnight in a refrigerator and the insoluble lead salt which separated out at this stage (B) was filtered The acids liberated from fractions A and B of the lead salt with dilute H_2SO_4 were in both cases insoluble in ether, petrol ether, alcohol, ethyl acetate, chloroform and carbon tetrachloride, and only partly soluble in benzene A part of the acids could not, therefore, be extracted with benzene and was left over undissolved with the lead sulphate The alcoholic mother liquor of fraction B gave, on removal of the solvent, the residual lead salts, from which the acids were liberated with dilute H_2SO_4 and extracted with ether The characteristics of the total acids and of the various acid fractions are given below

	Iodine value	*Neutralisation value*	*Neutralisation equivalent*
1 Total acids	70 3	184 2	304 2
2 Benzene soluble acids from fraction (A)	41 6	260 5	207 8
3 Benzene soluble acids from fraction (B)	45 8	168 1	332 0
4 Acids from the alcohol soluble lead salt	28 0	189 0	204 0

3 *Preparation of Methyl Esters of the Total Acids & Their Separation* — A mixture of 200 gm total acids, 800 gm absolute methyl alcohol and 10 c c concentrated H_2SO_4 was refluxed on water bath for 4 hr , in the course of which a portion of the methyl esters settled at the bottom The methyl alcohol was distilled off, the residue was taken up in ether, and the ethereal solution, after being first washed with dilute sodium bicarbonate solution and then with water, was dried over anhydrous sodium sulphate Methyl esters were obtained in nearly theoretical yield on distilling off the solvent from the filtrate and were separated in various fractions as follows

(i) *Distillation Method* — 61 5 gm of total methyl esters were distilled at a pressure of 8 mm Only a very small fraction could be distilled up to a temperature of 260°C , beyond which the esters crack The characteristics of the residue and the distillate are given below

	Total methyl esters	*Distillate*	*Residue*
Quantity (gm)	61 5	4 02	57 2
Saponification value	178 1	290 5	169 6
Saponification equivalent	315 0	192 9	330 7
Iodine value (Wijs)	63 4	63 64	64 75
Iodine value (Woburn s)		68 3	77 3

(ii) *Fractional Precipitation Method* — 300 gm of the residual methyl esters left over after distilling off the comparatively more volatile fraction *in vacuo* were dissolved in 600 c c of benzene To this solution was added a 1 1 mixture of acetone and 99 5 per cent methyl alcohol, equivalent to 10 times the volume of the esters, followed by the addition of a small amount of water till opalescence just developed An additional measured quantity of water was then added and the mixture set aside for 2 hr at room temperature (25°C) The supernatant liquid was decanted and the heavier precipitated portion freed from solvent by evaporation on a steam bath *in vacuo* This formed fraction I Eleven further fractions were obtained by successive addition of measured quantities of water to the decanted liquid according to the procedure described above From the final decantate, the last fraction (No 13) was obtained through complete removal of the solvent Of these fractions, the first was a dark-brown viscous liquid and the last a pale-yellow mobile liquid The rest of the fractions showed a regular gradation of colour and viscosity The physical and chemical characteristics of the various fractions are given in Table I

The last three fractions (11 to 13), forming a total of 68 gm , were dissolved in 40 c c benzene and 250 c c of methyl alcohol and separated into 5 fractions by gradual addition of water The chemical and physical characteristics of these fractions are given in Table II

A portion of the fraction No 3 (TABLE I) was hydrogenated in the presence of platinum catalyst, when it was found that 3 24 atoms of hydrogen are added on to a molecule of the ester (with reference to the molecular weight of the fraction) which is in close agreement with the results obtained for unsaturation by the iodine value (Wijs)

TABLE I

Fraction No	Amount of water added for each fraction	Amount %	Mol wt (Rast's)	Sap value 4 hr	Sap equivalent	Iodine value (Wijs)	Iodine value (Woburn)	Basicity	No of iodine atoms used per molecule
1	20	10 3	872 4	118 7	468 1	67 2	91 2	1 86	4 61
2	20	3 14	768 [illegible]	132 3	423 3	68 3	79 56	1 82	4 01
3	40	4 9	662 [illegible]	135 7	412 7	70 13	73 0	1 61	3 66
4	40	5 47	610 0	140 0	400 0	74 60		1 53	3 58
5	40	7 71	615 0	140 2	383 0	77 60		1 61	3 76
6	60	9 34	610 1	149 5	374 5	78 3		1 63	3 76
7	60	9 63	576 6	152 2	368 1	76 5		1 57	3 49
8	60	6 33	531 0	170 4	328 7	73 24		1 62	3 06
9	60	7 03	537 0	170 9	327 8	75 75		1 64	3 00
10	60	5 48	514 2	177 7	315 2	67 97		1 68	2 76
11	240	11 55	392 0	198 2	282 6	43 72		1 39	1 35
12	240	5 33	345 3	209 7	267 1	40 77	54 59	1 31	1 11
13	Evaporated	12 13	309 0	223 8	250 2	43 33	62 44	1 24	1 05

TABLE II

Fraction No	Amount %	Mol wt (Rast's)	Mol wt, cryoscopic	Sap value	Sap equivalent	Iodine value (Wijs)	Iodine value (Woburn)	Basicity	No of iodine atoms used per molecule
A	19 3	382 1	512 1	197 1	284 6	29 3	71 3	1 34	0 88
B	8 5	370 7	426 0	207 3	265 3	34 3	66 0	1 4	1 001
C	9 8	353 1	444 0	214 5	256 4	32 75	64 3	1 38	1 147
D	11 7	326 0	456 0	223 0	246 2	38 0	68 7	1 32	0 9543
E	40 1	305 0	484 3	225 6	243 6	34 87	109 5	1 26	0 8358

NOTE *The residue of 10 6 per cent of methyl esters could not be separated from the solution by further addition of water*

Discussion

1 The liquid product obtained through the depolymerization of castor oil gel by the method of Ranganathan and Siddiqui consists of a large proportion of carboxylic acids and their derivatives along with some hydrocarbons and aldehydes

2 The results of Bertram oxidation method of the gel show that it is not possible to remove the entire unsaturated acids from the depolymerized material The saponification and iodine values of the petrol ether-soluble fraction of the residual acids indicate that they may be the original unreacted portion The low iodine value and high saponification value of the ether-soluble portion lead to the conclusion that cleavage by oxidation might have taken place at the double bond in the side chain The iodine value 11 1 may be due to the presence of a sticky double bond in the cyclic nucleus of the acid molecules

3 The usual Twitchell's lead salt-alcohol method does not give a satisfactory separation of the total acids, the unusual behaviour being attributed to the absence of saturated acids and probably also to the cyclic nature of the component acids

4 The methyl esters of the carboxylic acids can be separated by the fractional precipitation into comparatively more homogeneous fractions Such a graded separation is not practicable by distillation

5 The values for molecular weights determined by Rast's method are generally much lower than those obtained with the cryoscopic method (TABLE II) This conforms to the observations of other workers that products like the acid esters associate in benzene

6 The basicity of various fractions (TABLE I) varies from 1 85 to 1 24 These values, along with their molecular weights, show that the heavier fractions consist mostly of mixtures of esters of dibasic acid resulting from the cracking of polymeric and dimeric acid chains, while the lighter fractions probably have a larger proportion of monobasic acid esters

7 The iodine taken up by heavier fractions approximately corresponds to 2 double bonds, while the lighter fractions show an iodine equivalent of only 1 atom The lighter fractions, therefore, may be primarily mixtures of acids having a sticky double bond in the nucleus, which is known to be resistant to halogen, and hydrogen addition

8 The present work supports the observation of Araki[8] that, on pyrolysis at low temperatures, viz 350° to 370°C, decarboxylation of the acids takes place to a very limited extent

Summary

The depolymerization of castor oil gel at 350° to 370°C by the method of Ranganathan and Siddiqui gives a dark viscous liquid which consists of a mixture of derivatives of dicarboxylic and monocarboxylic acids of an unsaturated character They may have been derived from cracked and uncracked products of monomeric, dimeric and also polymeric linoleic acid glycerides The depolymerized castor oil gel, in addition, consists of 7 to 8 per cent of unsaponifiable matter composed mainly of aldehydes and hydrocarbons

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Investigation on Indian Radioactive Minerals: I — Samarskite

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The formula $R_3^{II}[(Nb, Ta)O_4]_2$, $2R^{III}(Nb, Ta)O_4$, $R^{IV}(Nb, Ta)_2O_7$ has been assigned to the radioactive mineral samarskite on the basis of quantitative chemical analysis

THIS paper deals with the chemical examination of the radioactive mineral samarskite collected by G H Tipper[1] from Sankara Mica Mine of Nellore district, Madras Presidency The mineral also occurs in the district of Bangalore and Mysore in Mysore State and in Burma In this laboratory some radioactive minerals[2-4] were analysed in order to determine their geological age from Pb/U ratio Karunakaran and Neelkantam[5] published an analysis of Nellore samarskite, but the result is far from complete for assigning a chemical formula to the pure mineral With this end in view, a complete chemical analysis of the mineral was undertaken after a careful examination of the various analytical methods proposed from time to time

From a survey of the existing literature on samarskite, the Indian specimen from Nellore seems to be the purest and best The radiograph of the mineral (FIG 1) is perfectly homogeneous, showing its purity The mineral is velvet black, of high lustre, its streak is dark reddish brown, hardness 5-6 and specific gravity 5 6

Method of Analysis

Considerable time had been spent in the study of analytical methods suitable for making a complete chemical analysis Of

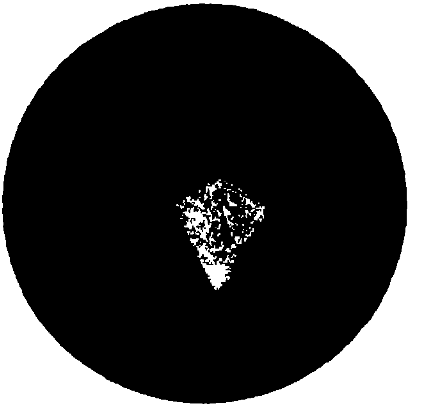

FIG 1 — RADIOGRAPH OF SAMARSKITE.

all the methods[8,9] tried, the method of Schoeller and Powell[9] gives the most reliable result , the other methods sometimes give misleading values In certain schemes of analysis, there is even no provision for determining some of the major constituents which leads one to get wrong values for the others Experience with some methods again has shown that they are not so simple and clear-cut in their separations as the original description might lead one to suppose

The mineral was crushed to pieces, selected crystals were freed from surface alteration matter, purified, powdered and passed through a 200 mesh sieve The method of Schoeller and Powell was employed with some modifications A complete scheme is appended The alkalies were estimated by Lawrence Smith fusion method Duplicate analyses were carried out and the mean values were used for the calculation of the chemical formula No hexavalent uranium was found in the sample as was evident from its decomposition with hydrofluoric acid, when no uranium was detected in the soluble portion

The analysis yielded the following results (TABLE I)

TABLE I — ANALYSIS OF SAMARSKITE FROM NELLORE

Nb_2O_5	44 54	ThO_2	1 21
Ta_2O_5	8 03	C_2O_3	0 81
TiO_2	1 62	Y_2O_3	13 93
			(At wt =132 0)*
SiO_2	0 22	MnO	1 00
SnO_2	1 48	PbO	2 04
Fe_2O_3	14 77	UO_2	6 93
CaO	0 94	Na_2O	0 29
MgO	0 03	K_2O	0 21
Al_2O_3	0 79	Loss on ignition	0 20
		Total	99 73

* The mean atomic weight was determined from the ratio $R_2(SO_4)_3\,8H_2O$ R_2O_3 after converting the sulphate octahydrate to oxide

Chemical Formula

Samarskite was regarded for a long time as a pyroniobotantalate Ramelsberg[10] gave the formula $R''_3R'''_2(Nb, Ta)_6O_{21}$ where $R'' =$ Fe, Ca, UO_2 and $R''' =$ rare earth metals Groth regarded it essentially as a pyroniobotantalate of rare earth metals, $R_4[(Nb, Ta)_2O_7]_3$, the iron, calcium and uranium being more or less accessory constituents According to Doelter[11], it is, however, considered to be composed of orthoniobate of yttrium and pyroniobates of uranyl, calcium, iron, etc , so as to be $Y_2(Nb, Ta)_2O_8\,R''_2(Nb, Ta)_2O_7\,(UO_2)_2(Nb,Ta)_2O_7$ where R denotes Ca as well as Fe Hess and Wells[12] separated the mineral in two parts, the more radioactive part which makes up the larger part of the mass richer in U, Th, Fe, Ta and Ca, whereas the other part was richer in rare earths The formula of the more radioactive part is essentially that of pyroniobate $2Y_2O_3\,3Nb_2O_5$ or $Y_4Nb_6O_{21}$, whereas the less radioactive part is nearer tnat of yttrium orthoniobate $Y_2O_3\,Nb_2O_5$ or $YNbO_4$, with equivalent replacement of minor constituents Iimora and Hata[13] made a complete analysis of two Korean samarskite samples and gave a formula, $R''_3[(Nb, Ta)O_4]_2$, $2R'''(Nb, Ta)O_4$, $R^{iv}(Nb, Ta)_2O_7$ On calculation from the analytical data obtained by us, we arrived at the above formula given by the Japanese workers Here the tetravalent radioactive constituents, viz UO_2 and thoria take the form of pyroniobotantalate, while the other basic constituents, the orthoniobotantalate form It corresponds to a composite salt consisting of two molecules of orthoniobotantalate and one molecule of pyroniobotantalate

Lead Content & Geological Age

The lead content of the mineral is much higher than that obtained by Sarkar and Sen Sarma[4] The geological age of the mineral calculated by them from the Pb/U ratio is 836 million years, which is about the age of Gaya minerals The Nellore samarskite is expected to be geologically much older So it appears that the sample analysed by Sarkar and Sen Sarma possibly belongs to Gaya

We extracted lead (as lead iodide) from several grams of the mineral and sent it to Prof A O C Nier of the University of Minnesota for the mass-spectrographic estimation of the lead isotopes The geological age of the mineral will be published elsewhere

Our grateful thanks are due to Prof P B Sarkar for his keen interest and helpful suggestions and to the Council of Scientific & Industrial Research for financial help Thanks are also due to the Director, Geological Survey of India, for supplying the mineral

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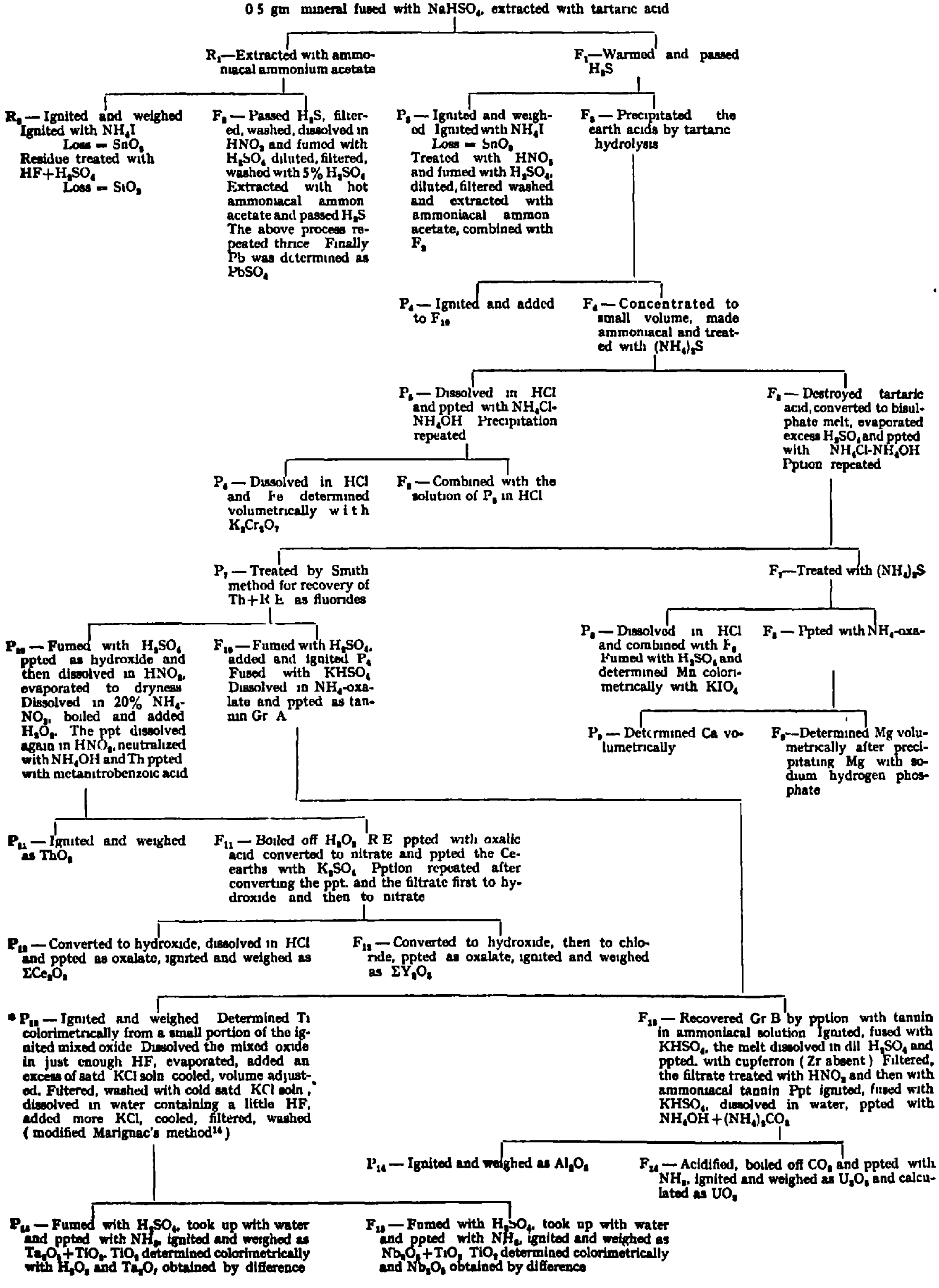
AN OUTLINE OF THE SCHEME OF ANALYSIS



0 5 gm mineral fused with $NaHSO_4$, extracted with tartaric acid

R_1—Extracted with ammoniacal ammonium acetate

F_1—Warmed and passed H_2S

R_2 — Ignited and weighed Ignited with NH_4I Loss = SnO_2 Residue treated with $HF+H_2SO_4$ Loss = SiO_2

F_2 — Passed H_2S, filtered, washed, dissolved in HNO_3 and fumed with H_2SO_4 diluted, filtered, washed with 5% H_2SO_4 Extracted with hot ammoniacal ammon acetate and passed H_2S The above process repeated thrice Finally Pb was determined as $PbSO_4$

P_3 — Ignited and weighed Ignited with NH_4I Loss = SnO_2 Treated with HNO_3 and fumed with H_2SO_4, diluted, filtered washed and extracted with ammoniacal ammon acetate, combined with F_2

F_3 — Precipitated the earth acids by tartaric hydrolysis

P_4 — Ignited and added to F_{10}

F_4 — Concentrated to small volume, made ammoniacal and treated with $(NH_4)_2S$

P_5 — Dissolved in HCl and ppted with NH_4Cl-NH_4OH Precipitation repeated

F_5 — Destroyed tartaric acid, converted to bisulphate melt, evaporated excess H_2SO_4 and ppted with NH_4Cl-NH_4OH Pption repeated

P_6 — Dissolved in HCl and Fe determined volumetrically with $K_2Cr_2O_7$

F_6 — Combined with the solution of P_8 in HCl

P_7 — Treated by Smith method for recovery of Th+R E as fluorides

F_7—Treated with $(NH_4)_2S$

P_8 — Dissolved in HCl and combined with F_6 Fumed with H_2SO_4 and determined Mn colorimetrically with KIO_4

F_8 — Ppted with NH_4-oxa-

P_9 — Determined Ca volumetrically

F_9—Determined Mg volumetrically after precipitating Mg with sodium hydrogen phosphate

P_{10} — Fumed with H_2SO_4 ppted as hydroxide and then dissolved in HNO_3, evaporated to dryness Dissolved in 20% NH_4NO_3, boiled and added H_2O_2. The ppt dissolved again in HNO_3, neutralized with NH_4OH and Th ppted with metanitrobenzoic acid

F_{10} — Fumed with H_2SO_4, added and ignited P_4 Fused with $KHSO_4$ Dissolved in NH_4-oxalate and ppted as tannin Gr A

P_{11} — Ignited and weighed as ThO_2

F_{11} — Boiled off H_2O_2 R E ppted with oxalic acid converted to nitrate and ppted the Ce-earths with K_2SO_4 Pption repeated after converting the ppt. and the filtrate first to hydroxide and then to nitrate

P_{12} — Converted to hydroxide, dissolved in HCl and ppted as oxalate, ignited and weighed as ΣCe_2O_3

F_{12} — Converted to hydroxide, then to chloride, ppted as oxalate, ignited and weighed as ΣY_2O_3

* P_{13} — Ignited and weighed Determined Ti colorimetrically from a small portion of the ignited mixed oxide Dissolved the mixed oxide in just enough HF, evaporated, added an excess of satd KCl soln cooled, volume adjusted. Filtered, washed with cold satd KCl soln, dissolved in water containing a little HF, added more KCl, cooled, filtered, washed (modified Marignac's method[14])

F_{13} — Recovered Gr B by pption with tannin in ammoniacal solution Ignited, fused with $KHSO_4$, the melt dissolved in dil H_2SO_4 and ppted. with cupferron (Zr absent) Filtered, the filtrate treated with HNO_3 and then with ammoniacal tannin Ppt ignited, fused with $KHSO_4$, dissolved in water, ppted with $NH_4OH+(NH_4)_2CO_3$

P_{14} — Ignited and weighed as Al_2O_3

F_{14} — Acidified, boiled off CO_2 and ppted with NH_3, ignited and weighed as U_3O_8 and calculated as UO_2

P_{15} — Fumed with H_2SO_4, took up with water and ppted with NH_3, ignited and weighed as $Ta_2O_5+TiO_2$. TiO_2 determined colorimetrically with H_2O_2 and Ta_2O_5 obtained by difference

F_{15} — Fumed with H_2SO_4, took up with water and ppted with NH_3, ignited and weighed as $Nb_2O_5+TiO_2$ TiO_2 determined colorimetrically and Nb_2O_5 obtained by difference

* Nb and Ta were also estimated by a modified method of Schoeller and Powell developed in this laboratory.

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The Estimation of Coconut Oil in the Presence of Mineral Oils & Other Vegetable Oils

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The standard procedure for the estimation of coconut oil in adulterated samples by the determination of Reichert value (R) and Polenske value (P) gives erroneous results when the adulterant is a mineral oil This has been traced to the interference of the mineral oil on the saponification of coconut oil For ensuring complete saponification it is essential that sufficient time should be allowed for the alkali to act on the oil mixture

The percentage of coconut oil present in adulterated samples can be read off from standard curves in which the percentages of coconut oil are plotted against R + P values

MINERAL oil known in the trade as white oil has been imported in large quantities into India and being clear colourless and odourless serves as an ideal and cheap adulterant for coconut oil Though primarily intended as a vehicle for the preparation of hair oils and cosmetics the unscrupulous merchants have been quick to use it to adulterate vegetable oils in general and coconut oil in particular Realizing the grave consequences that are likely to follow from the continued ingestion of mineral oil by the public the Government of India have recently banned its import into India but considerable stocks have been distributed throughout the Madras province as is evident from the fact that samples of coconut oil and gingily oil collected under the Madras Prevention of Adulteration Act even from small towns have been found to be adulterated with white oil

The qualitative detection of mineral oil is easily done by means of Holde's test[1] (cf *Aids to the Analysis of Food & Drugs* by Nicholls 6th edition p 344) 10 drops of the melted fat are saponified in a flask under reflux with 5 c c of approximately N/2 alcoholic potash and to the clear hot soap solution water is added in successive quantities of about 1 c c The solution is carefully observed after each addition of water In the case of vegetable oils the solution is clear after the addition of 5 c c of water whereas in the presence of as little as 1 per cent white oil the solution shows a faint opalescence The turbidity is not appreciable for quantities less than 1 per cent but is marked for quantities of 2 per cent and above If the only vegetable oil present is coconut oil the amount of white oil can be quantitatively estimated by determining the unsaponifiable matter But the method is tedious and time consuming due to the formation of emulsions Further the method does not identify the vegetable oil or oils present in the mixture The saponification value and the iodine value are useful in giving valuable preliminary information about the approximate proportion of vegetable oil and mineral oil but the method of choice will be the one which estimates the coconut oil specifically

Coconut oil (barring palm kernel oil) is unique in giving an average Reichert value of 8 0 and Polenske value of 16 0

It would be expected that the determination of these figures in oil mixtures would straightaway give the percentage of coconut oil Experiments show that this holds good in the case of mixtures containing coconut oil and a vegetable oil like groundnut oil which gives practically no Reichert and Polenske values These values were determined according to the standard Polenske method using 5 gm of the oil and glycerol soda for saponification Table I gives the Reichert and Polenske figures obtained for some oil mixtures It has been found convenient to take the sum of the Reichert and Polenske figures (R + P) as the basis for calculation purposes

TABLE I — REICHERT (R) & POLENSKE (P) VALUES FOR COCONUT OIL-GROUNDNUT OIL MIXTURES

Coconut oil, %	Groundnut oil, %	R	P	R + P	R + P (calculated)
0	100	0 2	0 1	0 3	
5	95	1 3	0 6	1 9	1 2
10	90	2 0	1 0	3 0	2 4
20	80	3 5	1 8	5 3	4 8
30	70	4 6	2 9	7 5	7 2
40	60	5 6	5 1	10 7	9 6
50	50	6 1	6 0	12 1	12 0
60	40	7 1	8 0	15 1	14 4
70	30	7 7	10 0	17 7	16 8
80	20	8 0	12 0	20 0	19 2
90	10	8 2	13 7	21 9	21 6
95	5	8 7	14 5	23 2	22 8
100	0	8 6	15 4	24 0	24 0

If, on the other hand, instead of groundnut oil, mineral oil is present, saponification with glycerol soda does not go to completion as readily as in the case of vegetable oils or ghee When ghee or a vegetable oil is mixed with glycerol soda and heated directly over the flame of a Meker burner, there is initially a frothing lasting for about 2 or 3 min and the solution suddenly clears up showing the end of the saponification In the case of mineral oil, there is more than one stage of frothing and the sudden clearing up is not observed By continuing the heating for another 2 or 3 min white fumes are evolved, but if the heating is discontinued at this stage, the resulting Reichert and Polenske values are sometimes too low and erratic For example, a mixture containing 20 per cent coconut oil and 80 per cent mineral oil gave R + P values ranging from 0 5 to 10·0. Obviously the mineral oil interferes with the complete saponification of the coconut oil and leaves one in doubt as to when heating has to be stopped

The experiments were repeated by adding glycerol soda to the oil, keeping the flasks corked overnight and saponifying the contents the next day After the initial simmering and frothing, a clear solution could be obtained, but to get concordant and reproducible values the heating was continued for a uniform period of 4 min in each case Table II gives the average figures obtained for coconut oil, mineral oil mixtures from four series of experiments using different mineral oils giving butyrorefractometric readings of 45 7, 63 2, 51·3, and 57 5 at 40°C and coconut oil having a reading of 35 0 Though exactly reproducible values could not be obtained as in the case of Reichert Wollney value for ghee, duplicate estimations gave R + P values to an accuracy of ± 1 0 from the average figure given in Table II, column 5

It may be pointed out that in the case of coconut oil-groundnut oil mixtures it makes no difference in the R + P values whether the oil mixture is saponified immediately after adding glycerol soda, or the next day after keeping the oil mixture in contact with glycerol soda overnight

TABLE II — REICHERT (R) & POLENSKE (P) VALUES FOR COCONUT OIL-MINERAL OIL MIXTURES

Coconut oil, %	Mineral oil, %	R	P	R + P	Coconut oil calculated from R + P	Apparent excess of coconut oil, col 6 minus col 1
0	100	0 1	0 1	0 2		
5	95	2 8	3 6	6 4	27	22
10	90	3 5	4 7	8 2	34	24
20	80	4 1	7 4	11 5	48	28
30	70	5 2	8 0	13 2	55	25
40	60	5 8	8 7	14 5	60	20
50	50	6 1	9 9	16 0	66	16
60	40	6 5	11 0	17 5	73	13
70	30	6 2	12 8	19 0	79	9
80	20	7 4	13 3	20 7	86	6
90	10	8 4	15 6	24 0	100	
95	5	8 6	15 6	24 2	100	
100	0	8 7	15 3	24 0	100	

A comparison of Tables I and II above shows that in Table I the R + P value in column 5 increases proportionately with the amount of coconut oil, but in the case of mineral oil mixtures the R + P values in Table II are exaggerated, especially for mixtures containing less than 50 per cent coconut oil leading one to infer wrongly the presence of about 25 per cent more coconut oil than is actually present. For mixtures containing more than 50 per cent coconut oil, the observed values are about 10 per cent higher than the actual amount present, but for mixtures containing small proportion of mineral oil, the R + P value is practically the same as for genuine coconut oil In the latter case, the amount of coconut oil is calculated from the saponification value

In order to seek an explanation for the peculiar behaviour of mineral oil, the R + P figure was determined by using instead of the usual 5 gm smaller quantities of coconut oil, the other reagents used being the same as for 5 gm The weights of oil correspond to the quantity present in 5 gm of the mixtures given in column 1 of Table II The values obtained are given in Table III

TABLE III — R + P VALUES FOR VARIOUS QUANTITIES OF COCONUT OIL

WEIGHT OF COCONUT OIL, gm	CORRESPONDING PERCENTAGE OF COCONUT OIL IN TABLE II	R	P	R + P
0.5	10	2.3	5.6	7.9
1.0	20	3.7	8.0	11.7
1.5	30	4.8	8.7	13.5
2.0	40	5.9	9.8	15.7
2.5	50	6.4	10.9	17.3
3.0	60	7.0	12.1	19.1
4.0	80	7.5	15.4	22.9

The R + P values in Table III correspond to the exaggerated values obtained for the respective percentages of coconut oil in Table II and not in Table I, showing thereby that in the presence of mineral oil the distillation of the volatile fatty acids tends to proceed as if only coconut oil is present, on the other hand, in the presence of the mixed fatty acids from groundnut oil the amount of volatile fatty acids distilled is proportional to the amount of coconut oil present

In order to see whether there was any loss of mineral oil during saponification, 5 gm of a mixture containing 4 gm mineral oil and 1 gm coconut oil was saponified as usual and allowed to cool After acidifying with dilute sulphuric acid and extracting with petroleum ether, 90 per cent of the mineral oil could be recovered, thereby showing that the loss of mineral oil during saponification was only 10 per cent which cannot account for the increased R + P values obtained

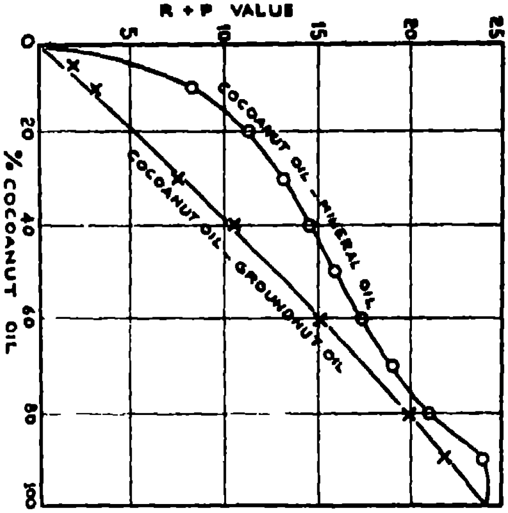

FIG 1

Fig 1 shows the curves obtained when the R + P values are plotted against the percentage of coconut oil when either groundnut oil or mineral oil is present as the adulterant The percentage of coconut oil in an unknown mixture can be read off from the obtained R + P value

The points of interest brought out by the above experiments are

1 In the case of mixtures of coconut oil and another vegetable oil like groundnut oil, the saponification is effected in 2 to 3 min and the R + P figures obtained are proportional to the amount of coconut oil

2 Mineral oil (white oil) interferes with the complete saponification of the vegetable oil in the mixture, if the saponification is done immediately after the addition of glycerol soda

3 If sufficient time is allowed for the alkali to act on the coconut oil, subsequent heating saponifies the oil completely

4 In the case of mineral oil-coconut oil mixtures, the observed R + P value by adopting the method given in (3) above is about 25 per cent higher than the calculated figure for mixtures containing less than 50 per cent coconut oil and about 10 per cent higher when it is over 50 per cent In such cases the actual percentage can be read off from a graph in which are plotted the percentages of coconut oil and the R + P values for known oil mixtures.

Search for Plant Microfossils in the Magnesian Sandstone Beds of the Punjab Salt Range*

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The absence of microfossils in samples of magnesian sandstone collected from the Punjab Salt Range has been confirmed, and further experimental evidence adduced in support of the Tertiary age for the Salt Range

THE controversy regarding the age of the Saline Series in the Punjab Salt Range is now about 60 years old The earliest worker on the geology of the Salt Range, Dr Fleming (1853) of the *Geological Survey of India*, assigned it a Tertiary age, the same as that of Kohat Salt on the other side of Indus But later A B Wynne (1878) and W T Blanford (1878) abandoned this view and the Saline Series was supposed to be of Cambrian age Since then a number of geologists have contributed remarkably uniform views on this vexed problem During recent years the controversy was again taken up by Dr E R Gee on the one hand and the late Prof Sahni and his co-workers on the other Dr Gee[2-4], on the basis of his extensive field study of the area, upheld a Cambrian age for the Saline Series although earlier[1] he himself believed that this salt was deposited during Tertiary period Prof. Sahni, however, approached the problem palaeobotanically and relying on the presence of plant fragments of the nature of cuticles, woody shreds, and also some Tertiary insect remains in the rock salt, salt marl, dolomites and oil shales of the Saline Series, ultimately decided in favour of a Tertiary age The work on these lines produced a large amount of valuable literature which was discussed in two symposia[5,6] with the result that after the publication of these symposia, the concensus of opinion has turned round towards a Tertiary age for the Saline Series

Recently Ghosh, Sen and Bose[7] have tried to re-examine the question of the age of the Saline Series They have analysed samples from the Saline Series and also from the Cambrian beds such as purple sandstone, neobolus shale, magnesian sandstone and salt pseudomorph shales which overlie the Saline Series. The reported discovery of post-Cambrian microfossils, especially in the Cambrian beds like purple sandstone, nebolus shale, magnesian sandstone and salt pseudomorph beds, has naturally aroused considerable interest, for, these finds are in contradiction to the findings of Sahni, his co-workers and others

This note deals with the microfossil investigation of a sample of magnesian sandstone, carried out at the instance of Prof Sahni in 1948 The work was done with a view to check upon the results quoted by Ghose, Sen and Bose on the recovery of a few carbonized wood pieces, with uni- to multi-seriate bordered pits, from magnesian sandstone sample 6292 collected from the eastern part of the Salt Range

Material

Sample S4 — a large slab of magnesian sandstone, with fucoid markings, collected by the Geology Department, Lucknow University, from Circuit House Hill, Khewra Gorge, Salt Range, Punjab, is bluish grey in colour, coarse grained, compact and hard

Technique — The rock sample did not show any cracks or crevices Small bits of rock were broken from inside all over the sample, ground and polished to avoid any foreign body sticking to the surface These pieces were examined under a dissecting microscope for microscopic cracks Pieces weighing about 8 gm were taken up for each maceration Each piece was exposed all over to a spirit lamp flame (wick of the spirit lamp is made of glass wool) for ½ min and put in a clean maceration jar To this jar about 20 c c of 4 per cent hydrochloric acid (filtered) was added and kept covered under a bell jar After a few days when the rock was completely broken down, the remaining acid was centrifuged out and the macerated material washed with filtered distilled water to eliminate all traces of the acid This residue was treated with ammonia and the alkali was later eliminated by washing, and the material stained with a drop of safranin for 5 min Excess of safranin was removed by repeated centrifuging Finally the residue was spread out in smears on a number of clean slides under a glass cover When the smear was dry the slides were mounted in Canada balsam

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* An investigation carried out under the Scheme for Measurement of Geological Time

Exactly similar procedure was adopted for maceration with hydrofluoric acid The maceration was done in a platinum crucible The excess of acid was neutralized by a concentrated solution of boric acid[12]

Every possible chance of external contamination during maceration was avoided, care having been taken in the finer details of the procedure Staining with safranin was done so as to distinguish all unstained contaminated plant matter in temporary and permanent preparations from the stained original microfossils of the rock Before staining, great care was taken to avoid any possibility of contamination by external plant material Occasionally a few dark grey or charred, also qualified as carbonized, pieces of organic fibres or tracheids may be found sticking to the slides due to imperfect cleaning of slides and coverslips The original microfossils, on being treated with acid and alkali, become lighter in colour, moreover they are stained with safranin

Over 60 permanent preparations and a number of smear slides were examined, but no microfossils were recovered The results are negative and do not show any evidence of the existence of a land flora or of a post-Cambrian age for these rocks

Great care must be taken in adopting this technique and much more caution is needed in the interpretation of the results This technique if used with due care gives accurate results By far the greatest danger in the use of this technique, even if practised with all due care, is the temptation to draw conclusions from scanty data.

Discussion

At the outset it is necessary to consider the implications of the investigations of Ghosh and others In the Salt Range, a set of four conformable Cambrian rocks lie unconformably over the Saline Series, i e purple sandstone, neobolus shales, magnesian sandstone and salt pseudomorph shales These are, in turn, overlaid uncomformably by the Talchir Boulder bed and other younger rocks

Of the Cambrian rocks overlying the Saline Series, the neobolus shales contain Brachiopod and Trilobite shells, and in magnesian sandstone, *Stenotheca*, a mollusc of lower Cambrian age, is found Hence, palaeontologically these rocks are of an undoubted Cambrian age During Cambrian times there is no authentic record of the existence of land plants whatsoever These rocks should, therefore, be completely devoid of microfossils of the nature of wood pieces or spores of land plants Careful researches by Hsü[8] on purple sandstone and by Sahni, Lakhanpal and Bhardwaj on the salt pseudomorph beds[14] together with the findings of the author, have revealed that these rocks are totally devoid of any microfossils of a post-Cambrian age-index-value, i e pieces of tracheids, cuticles or spores So far the results achieved by Lakhanpal on neobolus shale are also negative But strangely enough, Ghosh and others claim to have recovered Tertiary plant microfossils from all the beds of the Cambrian series including the neobolus shale

A perusal of the recent literature on this controversy will, however, reveal that the supporters of Cambrian school have all along relied on the stratigraphical evidence[11,12] and put forth numerous explanations to prove that the microfossils recovered by the palaeobotanists are simply contaminations But at least with regard to the microfossils in the dolomites and the oil shales within the Saline Series, some of the leading supporters of the Cambrian school, like Gee, Coates, Crookshank, Ghosh and Pinfold have accepted their inability to advance any satisfactory explanation for their presence there The evidence put forth by Sahni[10-12], Sahni and Trivedi[13], Trivedi[15], Sitholey[16] Lakhanpal[9] and Pratap Singh (in progress) from the Saline Series, especially the dolomites and oil shales, in the absence of any satisfactory evidence or explanation to the contrary, weighs heavily in support of the Tertiary age for the associated saline rocks The results of Ghose, Sen and Bose are irreconcilable with our findings.

The full text of the paper by Ghosh Sen and Bose containing details of the experimental technique employed has not been published so far and we therefore do not know what actual precautions they had taken to avoid external contamination

At the end of their communication Ghosh Sen and Bose suggest that the conclusion drawn by Sahni on the age of the Saline Series should be revised in the light of their recent investigations But they fail to realize that Sahni s microfossil evidence was not limited to maceration alone but was also extended to a study of microfossils lying *in situ* in numerous ground sections of the rocks investigated It may be made clear that unless and until geologists have some satisfactory explanation for the process of contamination in such compact rocks as dolomites and oil shales we have to abide by our findings

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Studies on Shark Liver Oil: II—Stability of Vitamin A

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Among the antioxidants tested for their effectiveness in minimising vitamin A destruction in shark liver oil during storage a mixture of isobutylgallate (0 2 per cent) and tartaric acid (0 01 per cent) was found to be the best The protective action of the additive decreases with rise in the temperature of storage Studies on molecularly distilled fractions of the oil show that vitamin A is relatively more stable in the 180°-220°C fraction The stability is correlated with the iodine number of the saponifiable fraction

THE development of rancidity and the destruction of vitamin A in fats and oils proceed simultaneously[1-9] and is mainly due to oxidation[10] The keeping quality of oils is consequently greatly influenced by the content of natural antioxidants[11] Following the observations of Moureu and Dufraisse[12] that hydroquinone can increase the stability of oils a large number of chemicals having similar antioxidative properties have been found and studied[13-24] But the toxicity of many powerful chemical antioxidants prevents their use in edible products

Most of the shark liver oils manufactured at present in India lose their vitamin A rapidly on storage[25-27] Hence a study of the methods of preservation of vitamin A in shark liver oil is of considerable importance to this growing industry With this view the comparative inhibiting properties of a few antioxidants used either alone or in combination with shark liver oil stored at room temperature (28°C) and at 50° ± 1°C have been studied and the results are reported here

Experimental

The sample of shark liver oil used in this work was of the highest quality obtainable and had an initial vitamin A content of 26 000 I U per gram It was filtered after neutralization and dried before use acidity and moisture are known to lower the efficiency of added antioxidants[27] 10 gm lots were taken into several clean uniform flat bottomed screw capped bottles Requisite amounts of antioxidants were weighed and incorporated with the oil after dissolving each antioxidant in a small quantity of a suitable solvent generally alcohol

Stability studies were carried out at (i) room temperature (28° ± 2°C) and (ii) 50° ± 1°C A thermostatically controlled incubator was used for the higher temperature Samples of untreated oil were also kept at 0 C in a refrigerator and at room temperature after wrapping the container bottle with brown paper so as to protect the oil from the effects of light The antioxidant treated samples at room temperature were also wrapped with paper so as to make possible comparison of results with those kept at 50° ± 1°C The synergetic effects of certain mixtures of inhibitors have been reported by a number of workers e g orcinol and phosphoric acid on lard[28] hydroquinone and lecithin on halibut liver oil[29] *kamala* dye and oleic acid on ghee[30] and isobutyl gallate and citric acid on shark liver oil[27] In the following studies the effects of certain combinations of some of the best inhibitors reported for shark liver oil are presented

The concentration of vitamin A was estimated[31] at weekly intervals during the first month of storage and later monthly Results are expressed as percentage loss (TABLES I III)

As may be expected the destruction of vitamin A was more in the oil exposed to ordinary conditions of light than when stored away from light (TABLE I) There was also more loss at higher temperatures[32] , this was true even in the presence of added antioxidants (TABLE III) Diphenylamine vitamin E ethyl gallate thiourea and isobutyl gallate exerted inhibiting action in the initial stages (TABLE II) Except for tartaric acid the combinations used with

TABLE I — RELATIVE STABILITIES OF SHARK LIVER OIL SAMPLES EFFECTS OF LIGHT & TEMPERATURE

Sample	Temperature °C	Destruction expressed as per cent loss at end of							
		1 week	2 weeks	3 weeks	4 weeks	8 weeks	12 weeks	20 weeks	32 weeks
1 Oil untreated (exposed to light)	28 ± 2	5.6	7.7	8.9	11.5	23.0	34.6	43.6	61.6
2 Oil untreated (cut off from light)	do	4.6	4.6	7.7	8.9	19.2	27.8	37.8	52.7
3 Oil untreated	0	nil	nil	nil	nil	1.9	3.0		10.5
4 Oil untreated	50 ± 1	7.7	12.3	18.0	19.2	23.8	38.6	55.0	69.6

TABLE II — RELATIVE STABILITIES OF SHARK LIVER OIL SAMPLES EFFECTS OF ANTIOXIDANTS AT ROOM TEMPERATURE (26° ± 2 C)

Antioxidant	Concentration %	Destruction expressed as per cent loss at the end of							
		1 week	2 weeks	3 weeks	4 weeks	8 weeks	12 weeks	20 weeks	32 weeks
1 Gallic acid	0.02	nil	0.77	3.8	4.6	8.9	14.4	23.0	46.1
2 Hydroquinone	0.02	nil		2.7	4.6	9.6	11.5	18.0	45.1
3 Diphenylamine	0.002	nil	nil	1.2	3.8	4.6	11.6	18.0	45.1
4 Vitamin E	0.002	nil	nil	1.9	2.7	4.6	11.6	14.4	46.1
5 Lecithin	0.25	7.54	7.7		9.6	11.6	19.2	22.1	52.7
6 Ethyl gallate	0.02	nil	nil	1.2	2.0	5.0	7.7	11.6	42.5
7 Thiourea	0.02	nil	nil	1.2	2.0	10.0	11.5	19.2	46.1
8 Isobutyl gallate	0.02	nil	nil	0.81		2.7	4.7	12.5	
9 Lecithin + hydroquinone	0.25 + 0.02	4.61	7.7		10.0	11.6	18.0	28.9	52.8
10 Isobutyl gallate + potassium dihydrogen phosphate	0.02 + 0.01	nil	nil	0.81	1.1	2.1	4.5	13.6	
11 Isobutyl gallate + hydroquinone	0.02 + 0.01	nil	nil	1.8	2.7		[illegible]	12.5	
12 Isobutyl gallate + tartaric acid	0.02 + 0.01	nil	nil	nil	1.8	2.0	2.7	8.0	
13 * Isobutyl gallate + o phosphoric acid	0.02 + 0.01	nil	nil	nil	2.7				
14 Isobutyl gallate + lecithin	0.02 + 0.01	nil	nil	1.81	2.7	3.7	4.5	13.6	

* Discolouration of the oil and formation of black sediment

TABLE III RELATIVE STABILITIES OF SHARK LIVER OIL SAMPLES EFFECTS OF ANTIOXIDANTS AT 50° ± 1 C

Antioxidant	Concentration %	Per cent loss at the end of							
		1 week	2 weeks	3 weeks	4 weeks	8 weeks	12 weeks	20 weeks	32 weeks
1 Gallic acid	0.02	0.8	1.9	4.6	7.7	11.5	26.9	45.1	61.1
2 Hydroquinone	0.02	4.6	5.6	7.2	8.6	11.6	28.0	43.8	
3 Diphenylamine	0.002	nil	2.6	3.6	4.2	8.9	19.2	43.8	58.8
4 Vitamin E	0.002	nil	0.77	1.9	3.8	8.9	19.2	40.0	59.6
5 Lecithin	0.25	5.6	7.7	7.8	10.0	14.4	26.9	44.6	60.3
6 Ethyl gallate	0.02	nil	0.77	1.9	4.2	7.7	19.2	45.1	59.6
7 Thiourea	0.02	1.9	5.6	7.8	7.7	11.6	15.0	43.1	55.3
8 Isobutyl gallate	0.02	nil	nil	3.5	5.0	6.3	8.0	19.3	
9 Lecithin + hydroquinone	0.25 + 0.02	5.6	7.8		8.9	11.5	23.5	45.1	58.0
10 Isobutyl gallate + potassium dihydrogen phosphate	0.02 + 0.01	nil	nil	4.5	8.0	9.5	13.6	18.1	
11 Isobutyl gallate + hydroquinone	0.02 + 0.01	nil	1.1	6.3	8.3	16.3	18.3	20.0	
12 Isobutyl gallate + tartaric acid	0.02 + 0.01	nil	2.7	4.5	6.3	9.5	12.5	18.0	
13 * Isobutyl gallate + o phosphoric acid	0.02 + 0.01	nil	nil	1.8	6.3				
14 Isobutyl gallate + lecithin	0.02 + 0.01	nil	1.1	6.0	8.0	9.5	13.6	29.3	

* Discolouration of the oil and formation of black sediment

isobutyl gallate did not enhance its effectiveness against vitamin A destruction Alkyl gallates, generally, could be used in practice without apparent harm, although no toxicity tests were carried out with this or the other antioxidants used

Accelerated Decomposition Tests with Molecularly Distilled Fractions of Shark Liver Oil — The destructive action of ultra violet light on vitamin A first noted by Zilva[32] with butter and later by Peacock[33], Willimott *et al*[34], and others with cod liver oils is very much more than the effect of exposure to daylight Irradiation could therefore, be employed to study accelerated decomposition for comparative purposes Such results with samples of shark liver oil obtained as distillates at different temperatures in the cyclic still[31] are given in Table IV 2 5 gm lots of oil from each fraction spread out evenly in a thin film in 10" petri dishes, were exposed to ultra violet rays from a Hanovia unit for varying periods ranging up to 4 hr when most of the samples had completely faded in colour The decomposition of vitamin A is expressed as per cent loss (TABLE IV)

The stability of vitamin A in the various fractions could perhaps be positively correlated with the iodine value of the saponifiable fraction which could be gauged from a comparison of the values for the oil fraction and of its corresponding unsaponifiable matter Thus the stability of vitamin A is the most in the fraction 180° 220°C the fraction below 180°C coming next The rate of destruction of vitamin A is the highest in the original shark liver oil and the fraction distilling between 220° and 240°C These latter are also the fractions with the highest iodine values of the saponifiable matter The melting point of total fatty acids is the highest in the fraction (180° 220°C) yielding the maximum amount of vitamin A and there is close parallelism between the rate of destruction of vitamin A and the percentage of total unsaturated fatty acids

Summary

(1) Relative stabilities of vitamin A in shark liver oil are influenced by (a) light, (b) temperature and (c) antioxidants either alone or in combinations at room temperature and at 50° ± 1°C

(2) Destruction of vitamin A was greater in the oil exposed to light than when stored away from light and was more pronounced at higher temperatures

(3) Of the antioxidants tried, the best combination was isobutyl gallate (0 02 per cent) and tartaric acid (0 01 per cent) The protective action of the antioxidants against vitamin A destruction was less at the higher temperature of storage although their general order of efficiency was the same at the two temperatures

(4) Shark liver oil and various molecularly distilled fractions from it were subjected to

TABLE IV — RELATIVE STABILITIES OF MOLECULARLY DISTILLED SHARK LIVER OIL FRACTIONS: EFFECT OF ULTRA-VIOLET LIGHT

	Fraction	Initial potency I U /gm	Yield of fraction %	Yield of vitamin A per fraction %	Destruction expressed as per cent loss at the end of 1 hr	2 hr	4 hr
1	Original shark liver oil	25 000	100 0		9 5	12 4	64 3
2	Distilled at below 180 C	1 98 750	1 58	12 6	9 5	15 6	21 4
3	180° 200 C	7 25 000	2 47	72 0	6 3	12 7	13 8
4	200° 20 C	60 000	6 1	14 8	7 2	10 1	12 1
5	220° 40 C	4 000	10 5	1 6	1 7	11 7	44 4
6	Residual oil		77 88				

Contrary to expectation there is no marked relationship between the vitamin A potency and its rate of destruction during storage or as a result of accelerated decomposition and any of the following characteristics free fatty acids, iodine value of unsaponifiable matter and peroxide number Even the per cent unsaponifiable matter bears no relation to the vitamin A content of any fraction or its stability It is possible however, that stability is determined by the presence or absence of varying amounts of natural inhibitors whose quantities cannot be deduced from the data accelerated decomposition by exposure to ultra violet light The rate of destruction decreased with increasing temperature of distillation up to 220°C The fraction collected above 220°C was relatively more unstable than fractions collected up to 220°C

(5) An attempt has been made to correlate stability results with the composition of the different fractions Significant amongst the observations are (a) lack of any relationship between per cent unsaponifiable matter and the vitamin content (b) positive correlation between the iodine value of the saponifiable fraction and the stability of vitamin A in a particular fraction and (c) parallelism between the rate of destruction of vitamin A and the per cent of the unsaturated fatty acids

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Foreign Fellowships & Scholarships

THE UNESCO HAVE RECENTLY ISSUED A publication entitled *Study Abroad* giving details of fellowships and scholarships offered by various countries and international organizations during 1949 50 1950 51 and 1951-52 Extensive surveys of programmes for short teaching abroad and workers exchange for educational and cultural purposes are also included The publication can be had from UNESCO Office University Buildings, Delhi

Letters to the Editor

STUDY OF DIFFERENT METHODS FOR FERMENTATION OF SUGARS BY YEASTS

IN A NUMBER OF GENERA OF YEASTS, THE species are identified by sugar fermentations and Stelling-Dekker[1] used growth in Einhorn tubes to determine sugar fermentations. Generally 20 c.c. of a 2 per cent solution of sugar are used by the older workers (Henrici and Stelling-Dekker). Henrici[2] has repeatedly found yeasts to give a vigorous fermentation with large volumes (20 c.c.) while smaller volumes (2 to 3 c.c.) gave only slight or no fermentation due to the greater diffusion of oxygen which favours oxidation rather than fermentative respiration.

The present investigation was undertaken to determine optimum conditions for securing an economical, rapid and reproducible method of fermenting sugar by yeasts. A comparative study of the relative efficiency of the (a) Einhorn tube method and (b) Durham tube method and the new method developed by us is recorded here.

(a) *Einhorn Tubes* (*Old Type*) — The standard Einhorn tubes, as used by Stelling-Dekker, require 25-30 c.c. of reaction mixture (140 cm × 15 mm). For comparison we have used a smaller Einhorn tube holding only 4-5 c.c. of the reaction mixture.

(b) *Durham Tubes* — Henrici uses for these fermentation tests tubes of large diameter (100 mm × 25 mm) furnished with inverted Durham tubes (75 mm × 10 mm) containing 20 c.c. of medium.

Lindegren[3] has modified the method and uses test-tubes (100 mm × 12 mm) containing 3 ml. of a 4 per cent concentration of the carbohydrate and an inverted Durham tube (50 mm × 7mm).

For our work, we selected very small test-tubes (75 mm × 10 mm) with inverted inserts (Durham tubes) (25 mm × 5 mm) and 2 c.c. of a reaction mixture containing 2 per cent sugar was used for each tube.

Material & Method

(a) The reaction medium of Spiegelman and Lindegren was employed for these studies and the medium was composed of

Yeast extract (Difco)	2 gm
Ammonium sulphate	1 gm
Peptone (Bacto Difco's)	3 gm
KH_2PO_4	2 gm
$MgSO_4.7H_2O$	0.25 gm
$CaCl_2$	0.13 gm
Sodium lactate	1 c.c. of 50 per cent solution
Sugar	20 gm

Total volume made up to 1,000 c.c. after adjusting the *p*H between 4.5 to 4.8.

The experiments were carried out with three different sugars — glucose, sucrose and maltose.

The following test organisms were used:

(i) *Saccharomyces cerevisae* 7 (N.C.T.C. 3006),

(ii) *Torula utilis* 3 (N.C.T.C. 3055),

(iii) *Saccharomyces carlsbergensis* (N.C.T.C. 3056), and

(iv) *Torula lactosa* (N.C.T.C. 3057).

The organism taken from an actively growing slant was dispersed in saline and the turbidity adjusted to a constant in each case. The proportion of inocula was one-tenth the volume to be fermented in each case. Media was steam sterilized for an hour every 24 hr., for three successive days. After inoculation the tubes were incubated at 28°C.

The results indicate that the "new Einhorn tubes" and the "new Durham" tubes are more sensitive for the study of sugar fermentations. In addition they are less time-consuming and secure a great economy of the rare and expensive sugars now difficult to procure. We have adopted this method for a systematic study of the fermentability of sugars by yeasts and bacteria maintained in the *National Collection of Type Cultures* (*C.S.I.R.*). Our grateful thanks are due to Mr. Sreenivasaya for his guidance and to the Council of

TABLE I

TYPE OF FERMENTATION TUBE	QUANTITY OF MEDIA c c	PERIOD OF FERMENTATION hr	RESULTS
Einhorn tube (old type)	25 to 30	More than 48	In all the cases fermentation was not complete at the end of 48 hr and the side tube was only in one case completely filled with gas The rest ½ to ¾ full
Einhorn tube (new type)	4 to 5	24	The side tube was in most cases filled completely with gas within 48 hr Maltose medium could be made to ferment in these tubes in contrast to the sluggish behaviour of the same medium when the 25 c c tube was used
Durham tube (new type)	2 to 2 5	24 to 48	Fermentation occurs within 24 hr In the case of Torula where both types of Einhorn tubes indicated slight or no fermentation these tubes showed active fermentation

Scientific & Industrial Research for financing a scheme of which this work forms a part

T N RAMACHANDRA RAO
V S KRISHNAMACHAR

Section of Fermentation Technology
Indian Institute of Science
Bangalore
September 10, 1950

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FLY ASH SEPARATOR FOR GAS TURBINE

I HAVE READ WITH INTEREST THE ARTICLE OF Mr S Guruswamy on *Development of Powdered-coal Gas Turbine for Locomotive Purposes* * In this article the author considers that it is of primary importance to remove the ash from the products of combustion before the hot gases are led through the turbine blades and he has suggested that investigations have to be done on the behaviour of ash under varying load and combustion conditions and its removal In this connection the following information received from Dr John I Yellott, Director of Research, Bituminous Coal Research Inc U S A, in September 1949 may be of interest to your readers I am enclosing a copy of our drawing D 365 (FIG 1) which gives the essential information about the type of fly ash separator which we are using in our gas turbine experiments This tube is manufactured by the *American Blower Corporation* of Detroit and our negotiations with them have been carried on through Mr H O Danz who is the head of their dust collector section

The drawing shows the general appearance of the tube which consists of an outer shell 21" long by 8½" I D A spinner is placed at the inlet end which causes the dust laden air to spin vigorously as it enters the tube The dust is thrown out to the wall by the centrifugal action of the spinning air stream and a small quantity of the air ranging from 6 to 12 per cent of the total flow is bled off through orifices at the discharge end of the tube The cleaned air emerges through the 6" dia outlet tube The dust now concentrated in a small portion of the air stream, is then collected in a secondary system and most of the air which was thus used to convey the dust is returned to the hot air stream. We plan to use the tube at an air flow of about 1 000 c f m at which condition the pressure drop at full gas turbine pressure will be about one psi

The expected collection efficiency of the tube is also shown plotted against dust particle size in microns You can relate this

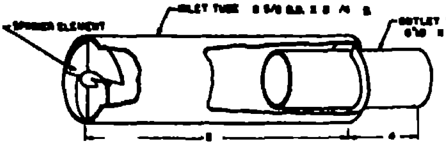

FIG 1 — DIMENSIONS OF AMERICAN BLOWER CORP SERIES 361 TYPE ST SEPARATOR TUBE

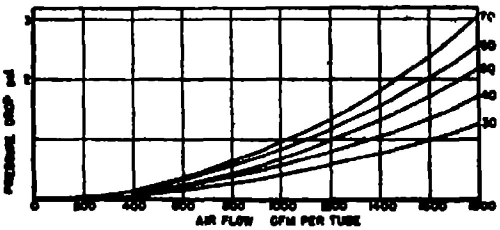

FIG 2 — PRESSURE DROP ACROSS AMERICAN BLOWER CORP TYPE 361 ST SEPARATOR AT 1275 F FOR VARYING AIR PRESSURES AND FLOW RATES

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* *J sci industr Res*, 1949 8, 486

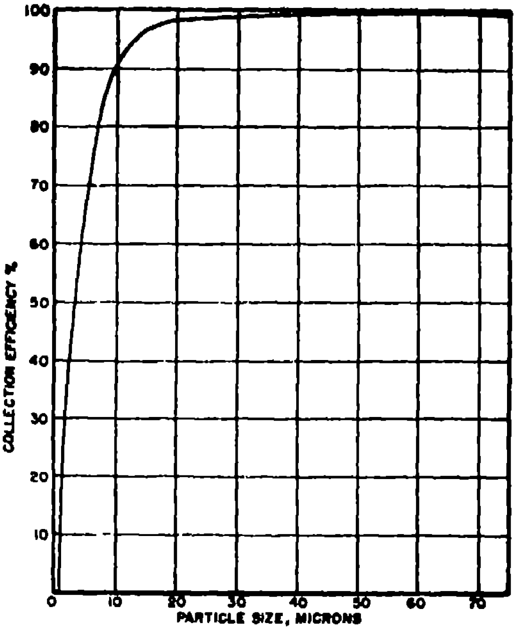

FIG 3 — COLLECTION EFFICIENCY *vs* PARTICLE SIZE FOR A B CORP TYPE 57 SERIES 361 SEPARATORS 425 CFM PER TUBE AIR AT 147 PSIA, 70 F 50 CFM SECONDARY FLOW, DUST ASSUMED TO BE SPHERES, SPECIFIC GRAVITY = 2 0

to screen size by remembering that 42 microns is the diameter of the opening in the finest screen, 325 mesh

" Our tests have indicated that the tube will collect most of the particles above 20 microns in diameter, and those which are smaller than this are not likely to do us much damage "

J C GHOSH

Directorate General of
Industries & Supplies
New Delhi
January 31, 1950

SUITABILITY OF CEYLON GRAPHITE FOR CRUCIBLE MANUFACTURE

THE CONDITIONS FOR PREPARING CRUCIBLES from Ceylon graphite, which would satisfy the exacting requirements of industry, have been determined in our laboratories

Two types of graphite are available from Ceylon, viz hard lumps and soft flakes The latter was selected for the trials, as they resembled Madagascar graphite (particularly after roasting at 1,000°C), which is extensively employed in the graphite crucible industry

Hand-picked small lumps (fixed carbon, 93 98 per cent , volatile matter, 1 0 per cent , ash, 5 02 per cent) were selected from the average run-of-mine ore, and were crushed successively in a roller mill and a burr-stone mill to separate individual flakes The flakes have an oily surface and are not easily wetted by clay They were roasted in a muffle furnace (at 1,000°C), cooled and sieved Two grades of flakes, viz −12 to +25 and −25 to +50 mesh were selected for the trials, the finer particles, which do not mould well, being rejected

A mixture of high refractory kaolin and ball clay was used as binder The results of analyses of the 2 clays are summarized in Table I

TABLE I

	KAOLIN %	BALL CLAY %
SiO_2	46 80	73 08
Al_2O_3	38 23	15 75
FeO and Fe_2O_3	0 27	0 62
TiO_2	0 09	2 10
MgO	0 07	0 34
CaO	0 12	0 53
Na_2O	0 07	0 15
K_2O	0 41	0 28
Moisture	14 28	7 11

The clays were separately dried (at 100°C) and ground to -100 mesh Different proportions of the 2 clays were blended to obtain different degrees of refractoriness Small crucibles of less than 30 lb capacity require a binder of higher refractoriness than larger ones Further, if the binder is too refractory, the crucible formed will be highly porous and the graphite burns off quickly

Grogs were substituted for quartz in the batching, and were prepared from burnt (at 1,400°C) bricks made of 3 parts of kaolin and 1 part of ball clay, sieved fractions −12 +50 were used The grogs were soaked in water before use

The clays were first mixed in a dry mixer of the cone type, with the addition of powdered felspar, talc, etc Graphite was next added and finally wet grog, the mixing being continued The mixture was then transferred to a pug mill sufficient water added and the pugged mass covered with a wet gunny was aged in a dark place for about a month with occasional intermittent pugging and addition of water The paste was divided into blocks each block separately de-aired by throwing against a wooden board covered with cloth and pressed

The pressed crucibles were allowed to dry for 3 to 4 hr till they become sufficiently stiff lips were formed and the surfaces polished They were then dried at room temperature for about a week and at 70° to 80°C for a few days before glazing

The glaze used had the following composition ball clay 19 5 per cent felspar 29 3 talc 19 5 quartz 19 5 red oxide of iron 8 5 per cent and manganese dioxide 3 7 per cent

The glazed crucibles were fired in a down draft kiln the crucibles being arranged inside saggars (containing saw dust or powdered coal) in inverted position over small supports Crucibles fired below 1 000°C required annealing before use while those fired above that temperature could be used without annealing

The quality of crucibles so prepared was tested by melting brass scrapings and noting the number of heats they could stand The composition of the crucibles which gave satisfactory performance is shown in Table II

TABLE II

GRAPHITE	CAPACITY 1-0 lb %	CAPACITY 90 lb %
(−12 to +25) mesh	57	
(25 to +60) mesh		57
Grog (−12 to +25) mesh	8	8
Ball clay	22	20
Kaolin	11	13
Felspar	2	2
No of heats	38	34

The author s thanks are due to Dr H N Das Gupta and to Prof H N Bose for their interest in the work and for helpful suggestions

K K MAJUMDAR

Indian School of Mines &
Applied Geology Dhanbad
September 28 1949

Indian Institute of Fruit Technology

RESEARCH WORK RELATING TO FRUIT technology was started before the war in the Lyallpur Agricultural College This work was partly financed from the funds of the Indian Council of Agricultural Research During the war the testing of samples of fruit products supplied to the defence services etc was entrusted to this laboratory

In 1946 a proposal to set up an Institute of Fruit Technology under the Ministry of Agriculture Government of India was considered and approved provisionally by the Government of India In view of the changed conditions consequent on the partition and the non availability of funds this scheme never materialized

A temporary laboratory on a small scale was set up at the Central College of Agriculture Delhi and classes for the training of students in fruit preservation and technique were being conducted Besides running the training classes this institution has also kept in touch with the fruit preservation industry and offered technical advice to it from time to time

Since this institution has not been functioning satisfactorily it has been merged with the Central Food Technological Research Institute Mysore under the auspices of the *Council of Scientific & Industrial Research*

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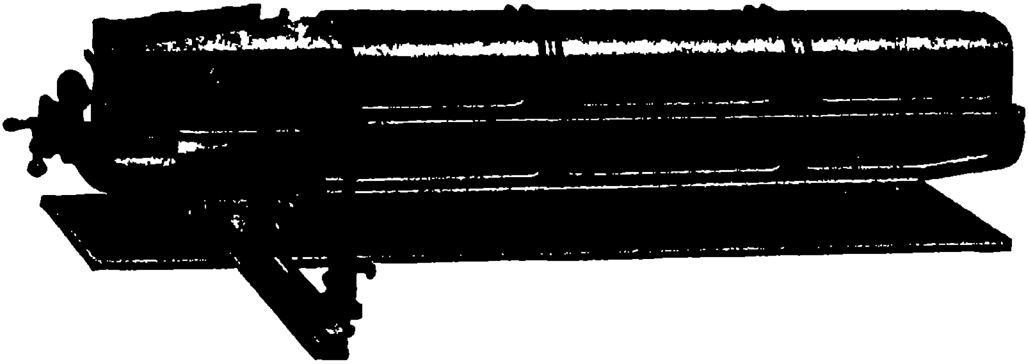

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Diffraction of Light by Amplitude Modulated Ultrasonic Beam

RAM RATTAN AGGARWAL, M PANCHOLY,
S PARTHASARATHY

The diffraction pattern due to the oscillation of a quartz crystal excited by an amplitude-modulated wave has been theoretically explained on the basis of Raman-Nath elementary theory.

THE phenomenon of diffraction of light produced by ultrasonic waves discovered by Debye and Sears[1] and Lucas and Biquard[2] has been explained by Raman and Nath[3] The expression derived by them for the position of the various diffraction lines is

$$\sin\theta = \pm n\,\frac{\lambda}{\lambda^*} \quad \cdots \quad (1)$$

where θ is the angle of diffraction, n the order of the diffraction image, λ the wavelength of light (*in vacuo*) and λ^* the wavelength of sound waves in the medium

When, however, two sound beams are simultaneously present in the medium, diffraction images corresponding to the sum and difference of frequencies are also produced Bergmann[4] observed that, when sound beams of frequencies n_1 and n_2 were present in the medium, the diffraction pattern showed, besides other lines, lines corresponding to the frequencies $n_1 \pm n_2$ In earlier investigations[5] carried out in these laboratories it was observed that when the crystal was excited simultaneously at two harmonics or when two crystals were used for sending two independent sound beams through the medium, the effect was similar to superposition of two diffraction gratings. It was, however, shown in another paper[6] that when the crystal is excited by an amplitude modulated carrier frequency instead of two independent carrier frequencies, a slightly different diffraction pattern would be obtained It is proposed to explain here the result reported in the previous note on the basis of Raman-Nath theory

The diffraction spectra obtained in this connection were published in a previous paper[6] There, Fig "a" shows the diffraction lines obtained by exciting the quartz crystal at the lower frequency, the various orders are in this case equally spaced Fig "b" shows a similar picture obtained by exciting the quartz plate at a higher frequency The separation between the successive orders in this case is greater and corresponds to the higher frequency The diffraction pattern shown in Fig "c" is obtained by exciting the quartz crystal simultaneously at both the frequencies (say n_1 and n_2) The picture shows lines corresponding to the frequencies n_1 and n_2 as also those corresponding to $n_1 \pm n_2$ In Fig "d", however, there are lines corresponding to the frequency n_1 as also those corresponding to $n_1 \pm n_2$ but about the zero order there are no lines corresponding to the frequency n_2 as in Fig "c"

This phenomenon can occur when the crystal is excited not by the two independent frequencies n_1 and n_2 but by a carrier frequency n_1 having its amplitude modulated sinusoidally at a frequency n_2 This observation is supported by the following argument

If μ_0 be the refractive index of the medium in the undisturbed state, the refractive index $\mu_{(x)}$ at a point x will vary in the following manner when a sound beam of wavelength λ^* is traversing the medium

$$\mu_x = \mu_0 + \mu_1 \ \mathrm{Sin} \frac{2\pi x}{\lambda^*}$$

(where axes of co ordinates are those as chosen by Raman and Nath)

If however the disturbance is not purely sinusoidal but has a sinusoidally modulated amplitude μ_1 in this expression should be replaced by

$$\mu_1 + \mu_2 \ \mathrm{Sin} \frac{2\pi x}{\lambda_1^*}$$

where λ_1^* is the wavelength of the modulating wave Therefore

$$\mu_x = \mu_0 + \left(\mu_1 + \mu_2 \ \mathrm{Sin} \frac{2\pi x}{\lambda_1^*}\right) \mathrm{Sin} \frac{2\pi x}{\lambda^*} \quad (2)$$

Thus

$$\mu_x = \mu_0 + \mu_1 \ \mathrm{Sin} \frac{2\pi x}{\lambda^*}$$
$$+ \frac{\mu_2}{2} \left[\mathrm{Cos} \left\{2\pi x \left(\frac{1}{\lambda^*} - \frac{1}{\lambda_1^*}\right)\right\}\right]$$
$$- \frac{\mu_2}{2} \left[\mathrm{Cos} \left\{2\pi x \left(\frac{1}{\lambda^*} + \frac{1}{\lambda_1^*}\right)\right\}\right] \quad (3)$$

Let P be a point on a distant screen parallel to the face of the medium from which light is emerging Further let l be the x direction cosine of OP The amplitude due to the corrugated wave at this point is given by the real value of the integral

$$\int_{p/2}^{p\,2} \mathrm{Exp} \left[2\pi i \left\{\frac{lx}{\lambda} - \frac{\mu_1 L}{\lambda} \mathrm{Sin} \frac{2\pi x}{\lambda^*}\right.\right.$$
$$- \frac{\mu_2 L}{2\lambda} \mathrm{Cos} \left\{2\pi x \left(\frac{1}{\lambda^*} - \frac{1}{\lambda_1^*}\right)\right\}$$
$$\left.\left. + \frac{\mu_2 L}{2\lambda} \mathrm{Cos} \left\{2\pi x \left(\frac{1}{\lambda^*} + \frac{1}{\lambda_1^*}\right)\right\}\right\}\right] dx$$

By putting

$$\frac{2\pi}{\lambda^*} = b \qquad \nu_1 = \frac{2\pi\mu_1 L}{\lambda}$$

$$\frac{2\pi}{\lambda_1^*} = b_1 \qquad \nu_2 = \frac{2\pi\mu_2 L}{\lambda}$$

$$\frac{2\pi}{\lambda} = u$$

the amplitude is given by the integral

$$\int_{p/2}^{p\,2} \mathrm{Cos} \left[(ulx) - (\nu_1 \ \mathrm{Sin}\ bx \right.$$
$$\left. + \frac{\nu_2}{2} \mathrm{Cos}\ \overline{b - b_1}\,x - \frac{\nu_2}{2} \mathrm{Cos}\ \overline{b + b_1}\ x) \right] dx$$

By actually calculating the value of the above integral we find that the different terms of this expression attain their maximum value when l or Sin θ is given by the following equation

$$\mathrm{Sin}\ \theta = N_1 \frac{\lambda}{\lambda^*} + N_2 \lambda \left\{\frac{1}{\lambda^*} - \frac{1}{\lambda_1^*}\right\}$$
$$+ N_3\ \lambda \left\{\frac{1}{\lambda^*} + \frac{1}{\lambda_1^*}\right\} \quad (4)$$

where θ is the angle which this emergent beam makes with Z axis and N_1 N_2 N_3 are any integers negative or positive even or odd This relation gives the positions of the different lines in the diffraction pattern

The intensity of the line (N_1 N_2 N_3) being the square of the amplitude is given by the expression

$$J^2_{N}(\nu_1) \quad J^2_{N_2}\left(\frac{\nu_2}{2}\right) \quad J^2_{N_3}\left(\frac{\nu_2}{2}\right) \quad (5)$$

(considering the intensity of the zero order line as unity)

Though (2) is mathematically identical to (3) yet the physical significance is different in the two cases (2) represents a *single* wave whereas (3) stands for the simultaneous presence of three *independent* waves In the latter case the different waves can interfere with each other so as to give combination lines therefore we have to take all integral values of N_1 N_2 N_3 in different combinations But if the waves are the sub-parts of a single wave (as in the case of a modulated wave) there is no interference The validity of taking different combinations of the integers N_1 N_2 N_3 is ruled out Any line in the diffraction pattern should be the consequence of a *single* sub-wave, i.e. we should consider the different values of either N_1, N_2, or N_3

For positive values of N's, the different lines are given by

	Position of the line	*Intensity*	
$N_1 = N_2 = N_3 = 0$	$\sin\theta = 0$	1	Zero order
$N_1 = 1,\ N_2 = N_3 = 0$	$\sin\theta = \frac{\lambda}{\lambda^*}$	$J_1^2(v_1)$	1st order for the carrier wave
$N_1 = N_2 = 0,\ N_3 = 1$	$\sin\theta = \frac{\lambda}{\lambda^*} + \frac{\lambda}{\lambda_1^*}$	$J_1^2(v_{2/2})$	Upper band around the 1st order
$N_1 = 0,\ N_2 = 1,\ N_3 = 0$	$\sin\theta = \frac{\lambda}{\lambda^*} - \frac{\lambda}{\lambda_1^*}$	$J_1^2(v_{2/2})$	Lower band around the 1st order
$N_1 = 2,\ N_2 = N_3 = 0$	$\sin\theta = \frac{2\lambda}{\lambda^*}$	$J_2^2(v_1)$	2nd order for the carrier wave

and so on

Similarly, negative values to N_1, or N_2, or N_3, produce the corresponding lines on the other side of the zero order line

The 1st order lines surrounding the zero order line and corresponding to the modulating (lower) frequency would be given by

$$\sin\theta = \pm\frac{\lambda}{\lambda_1^*} \qquad (6)$$

From the above derivations, it is seen that this value is not obtained for Sin θ in the case of amplitude modulated wave or, in other words, the diffraction line round the zero order should be absent

It may be noted here that working on diffraction produced by the sound track on variable density sound film Brown[7] obtained similar results Two notes of frequencies 305 c/s and 50 c/s recorded on the same film simultaneously showed in the diffraction pattern lines corresponding to 305 c/s, 50 c/s as also to frequencies 305±50 Thus all the main diffraction lines corresponding to 305 c/s, as also the zero order line were bracketed on either side by lines corresponding to 50 c/s However, when a 305 c/s note was modulated at 50 c/s and the modulated note recorded in the usual way, the diffraction produced by the sound track so obtained did not give any side lines surrounding the zero order

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Diffraction of Light by Ultrasonic Waves

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The first three terms in the expression for the intensity of any order diffraction line have been calculated by extending the results of the generalised theory of Raman and Nath on "Diffraction of Light by High Frequency Sound Waves" The experimental results on diffraction at oblique incidences, especially some of the special features, observed by various authors have been found in strict accordance with the theory.

DEBYE and Sears[1] in America and Lucas and Biquard[2] in France discovered independently and simultaneously that a beam of light traversing a medium agitated by sound waves produces a diffraction pattern Later on, Bar[3] investigated further this diffraction pattern Several theories were put forward by different authors[4-12]

It is interesting to remark here that all the theories developed so far are based upon the fundamental wave equation The various authors have solved this equation in different ways by making suitable transformations, assumptions and approximations Each development has its own practical use and can be applied under different conditions Brillouin's[4] results hold good when the frequency of sound wave is very high and only the 1st order lines are present in the spectrum Erwin David[6] has given comprehensive expressions for the 2nd order lines also Extermann and Wannier[7] have obtained numerical calculations for the intensity expression of different lines.

The latest and the most successful theory is due to Raman and Nath,[8-12] which is based upon certain simple optical considerations In parts I, II and III[8] of their theory they postulate that the diffraction is due to the corrugated form of the emerging wave-front, and that the corrugation may be regarded as due to density fluctuations in the medium and can be calculated from the phase changes accompanying the traversing beam, ignoring the amplitude changes. With the help of this elementary theory they have explained the presence of many orders of diffraction lines, the wandering of intensity in the different orders of spectra and the Doppler change in wavelength. This theory is applicable only when the ultrasonic frequency is comparatively low To cover a greater range of frequency, Raman and Nath[10] generalized their theory by taking Maxwell's equation governing the propagation of light through a quasi-homogeneous medium in which the disturbance is simple harmonic In another paper[11], Nath has solved a difference differential equation which gives an expression for the wave function He has found only a limited number of terms for this solution, still his results explain the presence of several diffraction lines, the variation in intensity of these lines, the asymmetry in pattern due to oblique incidence and the existence of Bragg's reflection for the first two orders In his thesis, he has shown further that nth orders show Bragg's reflection under certain conditions

In a subsequent paper[12] he has obtained the expression for the intensity of the 1st order line in the case of normal incidence when the ultrasonic frequency is high and only the 1st order line is present in the diffraction pattern His result is similar to that of Brillouin He has also shown that at a very high frequency even the 1st order may not be visible as the intensity of the 1st order line decreases, as we increase still further the ultrasonic frequency, a fact which has been experimentally verified by Ramachandra Rao and Bhagavantam[13].

Some Recent Developments

Parthasarathy in his paper[14,15] has obtained some remarkable results by tilting the crystal giving out sound waves and thus changing the angle of incidence The chief points of his experiments[14,15] are

1 The intensities of the diffraction lines favouring reflection increase as the angle of incidence is increased, whereas the diffraction lines on the other side become fainter

2. Each diffraction line attains its maximum intensity at corresponding Bragg's angle The intensities fall off as the angle changes from this value The fall is more rapid at higher sound frequencies

3 The difference in intensities of the same order lines is less marked for lower order lines, so much so that at lower frequencies, the 1st order lines have nearly equal intensities for all inclinations

The same results have been obtained by Ramachandra Rao and Bhagavantam in their recent work[13] They have obtained similar results for the 1st order lines as they have used higher frequencies As a matter of fact, the same results can be obtained for any order of diffraction line by suitably adjusting the frequency To get an idea about the intensity of any order line, at oblique incidences, it is very necessary to push forward the calculations of Nath The work published in this direction by Nagabhushan Rao[16] will be pursued further The notations and symbols used by Raman and Nath in their generalized theory will be employed (*see* APPENDIX I) To avoid all mathematical calculations, only the final results will be mentioned

Generalized Expressions for Intensity

Nagabhushan Rao[16] has shown that the general expression for the coefficient $A_{n,1}$ is

$$A_{n,1}=\frac{C_1+C_2+C_3+\ \cdot\ \cdot\ \ \ \cdot\ \cdot\ \ C_n}{2\,(n+1)}$$

The same expression can also be obtained by applying the method of induction to the expressions for $A_{1,1}$, $A_{2,1}$, $A_{3,1}$ given by Nath

By substituting the values of different C's, he has further shown that $A_{n,1}$, $A_{n,2}$, $A_{n,3}$ are given by the expressions

$$A_{n,1}=\frac{i\rho n}{12}\left[(2n+1)-6\alpha\right]\quad\ldots\ldots\quad(1)$$

$$A_{n,2}=-\rho^2 n\left[\frac{(2n+1)\ (10n^2+13n-3)}{1440}-\frac{\alpha n\ (n+1)}{12}+\frac{\alpha^2}{24}(3n+1)\right]-\frac{1}{4(n+1)}\ .\ .\ (2)$$

$$A_{n,3}=-\frac{i\rho^3}{48}(A^*)-\frac{i\rho}{48\,(n+1)}\left[(2n^2+n+2)-6n\alpha\right]\ \ldots\ldots\ (3)$$

where A^* is given by the expression

$$\frac{n(2n+1)}{7560}\left[140n^4+476n^3+205n^2-251n+60\right]$$
$$-\frac{n^2(n+1)\alpha}{60}\left[20n^2+36n-11\right]$$
$$+\frac{n\alpha^2}{30}\left[30n^3+55n^2+9n-4\right]$$
$$-\frac{n^2(n+1)\alpha^3}{1}$$

Proceeding exactly in a similar way, it can be shown that $A_{n,4}$ is given by the relation

$$A_{n,4}=\rho^4\,(A^{**})+\rho^2\,(B^{**})+\frac{1}{(n+1)\ (n+2)\ 2^5}\ \ldots\ldots\ (4)$$

where A^{**} is given by the following expression

$$\frac{n(2n+1)}{16\times5443200}\left[1400n^6+8820n^5+13058n^4-5529n^3-8788n^2+8049n-1890\right]$$
$$-\frac{\alpha\,n^2\ (n+1)}{16\times22680}\left[140.n^4+616n^3+373n^2-538n+165\right]$$
$$+\frac{\alpha^2\,n}{16\times15120}\left[420\,n^5+1736n^4+1477n^3-494n^2-205n+90\right]$$
$$-\frac{\alpha^3\,n^2\ \ (n+1)}{16\times90}\left[5n^2+10n-3\right]$$
$$+\frac{\alpha^4\,n}{16\times360}\left[15n^3+30n^2+5n-2\right]$$

and B^{**} is equal to the following expressions

$$\frac{1}{16\times360\times(n+1)}\left[20n^4+36n^3+79n^2+33n+30\right]$$
$$-\frac{\alpha n}{16\times3\times(n+1)}\left[n^2+n+2\right]$$
$$+\frac{\alpha^2}{16\times6\times(n+1)}\left[3n^2+n+2\right]$$

Having thus calculated the values for first five coefficients in the expression for Ψ_n, we can find 1st three terms in the expression for intensity for nth order

The 1st term is given by

$$\left[\frac{x^n}{2^n\,n!}\right]^2 A^2_{n,o} = \frac{x^{2n}}{2^{2n}(n!)^2} \qquad (5),$$

$$(\text{Since } A_{n,o} = 1)$$

The 2nd term has the following value

$$-\frac{x^{2n+2}}{2^{2n}\,(n!)^2}\left[\frac{1}{2(n+1)} + n\rho^2 \left\{\frac{16n^2+2n-3}{720} - \frac{n\alpha}{12} + \frac{\alpha^2}{12}\right\}\right] \qquad (6)$$

The 3rd term in the expression for the intensity of nth order has the following value

$$\frac{x^{2n+4}}{2^{2n}(n!)^2}\left[\rho^4 L + \rho^2 M + \frac{2n+3}{16(n+2)\,(n+1)^2}\right] \qquad (7)$$

where L and M have the following values

$$\begin{aligned} L = {} & \frac{n\,(2n+1)}{24\times 144\times 2100}(896n^4-96n^3 \\ & -1238n^2+1173n-315) \\ & - \frac{\alpha\, n^2}{1440\times 42}\times(112n^3+12n^2-85n+45) \\ & + \frac{\alpha^2\, n}{60480}\times(322n^3-30n^2-85n+45) \\ & - \frac{\alpha^3\, n^2}{720}\times(5n-1) \\ & + \frac{\alpha^4\, n}{1440}\times(5n-1) \end{aligned}$$

$$M = \frac{1}{24}\left[\alpha^2 - \alpha n + \frac{16n^3+18n^2+5n+15}{1440\,(n+1)}\right]$$

The expression for intensity of negative orders can be obtained from the above expression itself by putting $-\alpha$ for α

Discussion

In many problems, only the first two or three terms in the expressions for intensities of the diffraction lines are very important The variations in intensities of the different lines can, therefore, be discussed easily with the help of these results Some of the important deductions which follow are mentioned below.

1 *The Variation of the Intensity of the Last Visible Line in the Spectrum can be Explained Theoretically* — In any experiment, let (n+1)th order line be absent for all positions of the crystal The intensity of the nth order line may be written as

$$I_n = \frac{x^{2n}}{2^{2n}(n!)^2}\left[1 - x^2\left\{\frac{1}{2(n+1)} + n\rho^2 \left(\frac{16n^2+2n-3}{720} - \frac{n\alpha}{12} + \frac{\alpha^2}{12}\right)\right\}\right] \ldots\ldots (A)$$

As we can neglect other terms, we derive the following conclusions easily

(i) I_n is maximum when $\alpha = \frac{n}{2}$, when the inclination corresponds to Bragg's reflection angle for the nth order line

(ii) I_n is greater than I_{-n}, the intensity of the nth order line is greater on the side which favours reflection

(iii) The variation in intensity for different angles of inclination is proportional to ρ^2

Therefore, the variation is sharp and quick when ρ is large or when the ultrasonic frequency is high This fact was first well established by Parthasarathy and subsequently by other workers in the field They have shown that the range of the angle of incidence for which the last visible line is present decreases as we increase the frequency

2 *Diffraction at Oblique Incidences* (*Low Frequency*) — For ultrasonic waves with low frequency $\rho < 1$ in addition to $x < 1$ Therefore, the successive terms in the expression for intensity of any order line decrease steadily Further, since the alternate terms have positive and negative signs, only the first two terms in the expression may be considered to have a rough idea of the variation in intensities of the different order lines, as the angle of incidence is changed Consequently, (A) may be taken to represent the intensity of the nth order line in this case

The variation in intensity of the nth order line for different angles of incidence is, therefore, proportional to

$$n\,\rho^2\,(n\alpha - \alpha^2) \quad . \qquad \ldots\ldots (B)$$

A careful study of this expression leads us to the following results

(a) *Diffraction Lines on the Side Favouring Reflection* — α is always positive, if we consider the lines on the side favouring reflection. A small increase in the value of α, from its initial zero value (normal incidence), causes an increase in (B), i e the intensities of the different lines become greater by tilting the crystal a little This excess in the intensity of the nth order is maximum when $\alpha = \frac{n}{2}$ (this angle corresponds to Bragg's reflection angle), and may be sufficient to develop certain lines of higher order which are invisible when the incidence is normal The maximum number of diffraction lines will appear when $\alpha = \frac{S}{2}$ if S is the number of these lines in this position (found experimentally)

A further increase in α means a decrease in the value of (B) and, therefore, the intensities as well as the number of diffraction lines decrease The number of diffraction lines comes to its initial value when $\alpha = S$

If $\alpha > n$, (B) is negative and there is a further steady decrease in the intensities as well as the number of diffraction lines If n is large, the variation in intensity is also large and hence the lines of the higher order disappear earlier

(b) *Diffraction Lines on the Other Side of the Zero Order* — α is negative if we consider lines on this side (B) always decreases as the angle of incidence is increased The number as well as the intensities of the diffraction lines will decrease steadily

(c) *Symmetry in the Pattern when the Angle of Incidence is High* — The difference in the intensities of the same order lines depends upon the terms involving odd powers of α, i e, $n^3 \rho^2 \alpha$ This difference is large if n is large and also if ρ is high When ρ and n are small, the difference is correspondingly less In other words, the intensities of the 1st order lines will be always nearly equal if the ultrasonic frequency is low and the diffraction pattern will be symmetrical only if the 1st order lines are present

In Parthasarathy's experiment[15], where he uses a sound wave of frequency 7 37 × 10^6 c /s, a change of 6 5′ in the angle of incidence corresponds to a unit change in the value of α and the lines of the order higher than 6 are always absent, i.e. $s = 6$. Theoretically, we expect that

> the diffraction lines, on the side favouring reflection, should become more intense as the angle of incidence is gradually increased The number of diffraction lines should also increase The diffraction pattern should show the maximum number of lines on this side at an angle of incidence of 20′ nearly Then the number of diffraction lines should decrease and come to its original number when the angle of incidence is 40′ This decrease should continue steadily as the angle is increased further The diffraction lines of the other side should diminish in number gradually as the angle of incidence is increased from the very beginning Finally, the pattern should become symmetrical when the angle of incidence is so large that only the 1st order lines are present

A careful study of the pictures[15] reveal that the experimental results are in strict accordance with the theory

I am very thankful to Dr S Parthasarathy for his interest and guidance in this work

APPENDIX I

Significance of the Different Symbols Used

λ = Wavelength of light wave
λ^* = Wavelength of sound wave
μ_0 = Refractive index of the medium
μ = Maximum variation in the refractive index of the medium
L = Length of the cell
φ = The angle of incidence

$$\xi = x = \frac{2\pi\mu L}{\lambda}$$

$$\alpha = \frac{\mu_0 \lambda^*}{\lambda} \tan \varphi$$

$$\rho = \frac{\lambda^2}{\mu_0 \mu \lambda^{*2}}$$

$A_{n,r}$ is the coefficient of x^r, in the expression for Ψ_n, the wave function for the nth order line

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Chemical Examination of Indian Squill

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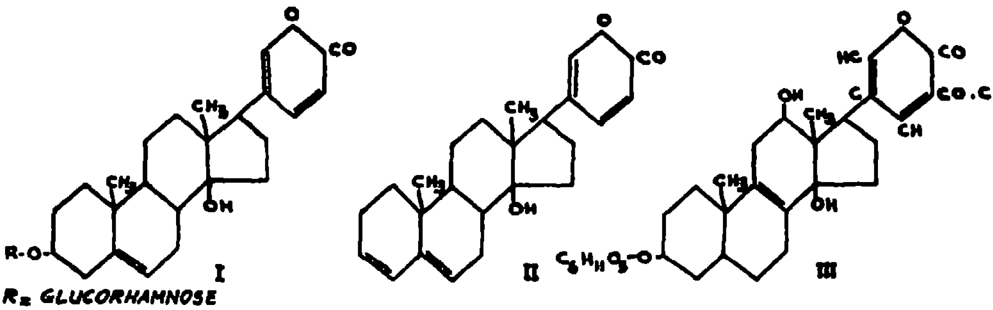
Indian squill, as available in the market in the form of dry slices, yields two glycosidal fractions (1) The water-insoluble (A) is found to be a mixture of glycosides, which on hydrolysis with acid yields, besides glucose and rhamnose, scillaridin A as predominantly the major component and as a minor component a new aglucone melting at 265°-67°C. and having the molecular formula $C_{[illegible]}H_{[illegible]}O_4$ Scillaren A may be considered to be the major glycoside of fraction (A); and (2) the water-soluble part (B) resembling scillaren B gives on hydrolysis a crystalline aglucone, m p. 227°-30°C. and glucose.

SQUILL is one of the oldest drugs in medicine and its preparations have largely been used for their expectorant, cardiac stimulant and diuretic properties Bulbs of *Urginea scilla* are official in the British Pharmacopoeia and of *Urginea maritima* in the European and American Pharmacopoeias Indian squill, available in the market in the form of sliced dry bulbs, consists of two varieties, *Urginea indica* Kunth and *Scilla indica* Roxb, which grow abundantly in sandy soils, especially near the sea coast *Urginea indica* also grows in the drier hills of the lower Himalayas and in the Salt Range of the Punjab and North-West Frontier Province at an altitude of about 2,000′ Chopra, De and Mukerjee[1] have shown that the Indian drug from the two species is equal in therapeutic action to the imported European squill It was even included in the 1914 B P and in the fourth addendum to the 1932 B P, though this has been deleted now from the 1948 edition

According to Stoll[2] the active principles of squill have special merits, they not only fulfil all the requirements of a cardiotonic of the digitalis type and produce copious diuresis, but also act in cases where digitalis and strophanthus fail to act, or act insufficiently or where intolerance to digitalis exists Further, on account of their high therapeutic index and their rapid elimination, they are useful in cases where prolonged treatment is necessary

Past Work on Squills

Though the chemical investigation of European squill was started as early as 1879 by Merck[3] and followed by several others, the genuine cardiac glycosides of *Scilla maritima* were first isolated by Stoll and co-workers[4] and reported in 1933 They were able to separate two fractions: (i) water insoluble containing scillaren A and (ii) water soluble containing scillaren B The chemistry of scillaren A has been fully worked out by Stoll *et al*[5] and its constitution represented as in (I) On hydrolysis it yields scillabiose (glucorhamnose) and scillaridin A (II) with the simultaneous splitting of a molecule of water Scillaren B has not been studied in detail, but is known to yield, on hydrolysis, glucose and a small quantity of a crystalline aglucone, m.p. 228°-29°C.



Recently Stoll and Renz[6] have obtained a new crystalline cardiac glycoside, scilliroside from the red variety of *Scilla maritima* which has been extensively used as a rat poison From available evidence it has been assigned the structure (III) (Stoll *et al*[7])

From two South African species of squill, *U rubella* and *U burkei*, Louw[8] has reported the isolation of rubellin and transvaalin respectively Details regarding their chemical structure are not yet made available, although information is given regarding their melting point, optical activity, ultra-violet absorption and chemical composition Rubellin is claimed to be the most active of the glycosides ouabain, lanatoside C, digoxin and digitoxin

Present Work on Indian Squill

No systematic chemical study of Indian squill seems to have been made before With a view to isolate the active principles and compare them with already known glycosides, the present work was undertaken In the first instance the commercially available dry material consisting of a mixture of *Urginea indica* and *Scilla indica* has been employed It was obtained from Calcutta and consisted of colourless slices, well dried and well preserved, it was converted into a coarse powder before use The method adopted is essentially that of Stoll and co-workers[4] with slight modifications The mixture of glycosides was separated into water-insoluble and water-soluble fractions The process of purification was followed by the Liebermann colour reaction of sterols

The water-insoluble portion marked (A) of the total glycosides was obtained as a micro-crystalline powder decomposing at 195°-200°C It was very bitter to taste and gave colour reactions similar to scillaren A, but showed a considerably lower melting point Since attempts at further purification by fractional crystallization proved futile, it was directly hydrolysed with sulphuric acid in aqueous methanol The product appeared to be a mixture of aglucones and was fractionally crystallized The major fraction A_1, which crystallized first, was identified as scillaridin A by means of melting point, optical rotation, colour reactions, lactone titration and preparation of iso-scillaridinic acid methyl ester This identity was further confirmed by direct comparison with an authentic sample of scillaridin A kindly supplied by Prof A Stoll of Basel to whom our thanks are due The minor component A_2 was a crystalline substance melting at 265°-67°C and showing considerable depression in the melting point when mixed with scillaridin A Moreover, its colour reactions were also different as indicated below (TABLE I) Elementary analysis corresponded to the formula $C_{26}H_{32}O_4$

The sugars obtained as a result of acid hydrolysis could be identified as glucose and rhamnose by the preparation of their osazones

The water-soluble fraction (B) was obtained as an almost colourless amorphous powder which, on acid hydrolysis, gave an aglucone melting at 227°-30°C A similar melting point (228°-29°C) was reported by Stoll *et al*[4] for the aglucone from scillaren B

Summing up the results of the present work, the glycosides present in Indian squill could also be divided into two fractions, (1) water-insoluble (A) and (2) water-soluble (B) Though it has not been possible to isolate a pure sample of scillaren A, from the products of hydrolysis it could be concluded that it is the major component of the fraction (A) This contains another glycoside in minor quantities yielding on hydrolysis a new

TABLE I — COLOUR REACTIONS

SUBSTANCE	COLOUR OBSERVED AFTER (min.)					
	0	2	5	10	30	60
(1) With Conc. Sulphuric Acid						
Scillaridin A	Cherry red	Red	Magenta	Violet	Bluish green	Green
Aglucone A_1	Cherry red	Red	Magenta	Violet	Bluish green	Green
Aglucone A_2	Magenta	Blue	Green (bluish green ppt.)	Fades		
(2) Liebermann Test (Acetic Anhydride and Sulphuric Acid)						
Scillaridin A	Carmine red slowly changing to blue, bluish green and finally green					
Aglucone A_1	Carmine red slowly changing to blue, bluish green and finally green					
Aglucone A_2	Carmine red changing quickly to green					
(3) Rosenheim Test (*Trichloracetic Acid*)						
Positive in all the three cases — a pink colour changing to blue after standing for some time						

aglucone having a bigger molecular size than scillaridin A But the quantity so far isolated has not been adequate for a more detailed study Though the fractionation of the aglucones was easy, similar separation of the glycosides has not till now been successful Further work is in progress

Experimental

Isolation of the Glycosides — 1 kg of dry Indian squill in coarsely powdered form was extracted three times with cold 95 per cent alcohol (4 litres, 10 hr each time) The combined extract was concentrated *in vacuo* below 50°C to a syrupy consistency The syrup was treated with a large volume of ether to remove the ether-soluble portion and the ether-insoluble portion (12·0 gm) was dissolved in 60 per cent aqueous alcohol. The solution was decomposed with a saturated alcoholic solution of basic lead acetate and filtered The precipitate was washed with a little dilute alcohol and the mixed solution deleaded with a lukewarm solution of disodium hydrogen phosphate (30 per cent W/W) It was filtered again and the precipitate washed with very dilute alcohol The combined filtrate was made neutral with sodium bicarbonate and saturated with common salt From this solution the glycosides were repeatedly extracted with chloroform-methanol mixture (4 1) and the combined extract dried over anhydrous sodium sulphate and evaporated to dryness *in vacuo* The residue was finally dried in a vacuum desiccator, when a light-yellow brittle powder was obtained, yield, 3·0 gm. It was quite bitter to the taste and non-reducing to Fehling's solution. It gave a cherry-red colour with conc. sulphuric acid. With acetic anhydride and a drop of conc sulphuric acid in glacial acetic acid solution, a play of colours — deep red, pink, blue and bluish green — was observed (Liebermann reaction).

Separation into Water-insoluble (A) & Water-soluble (B) Fractions — The above mixture of glycosides was dissolved in the minimum quantity of methyl alcohol and a large volume of water (about 10 times) was added with constant stirring when nearly three-fourths of the total glycosides was thrown out as a light sticky precipitate The supernatant liquid was carefully decanted off and the precipitate washed repeatedly with small quantities of ice-cold water till a fine granular solid resulted The water-insoluble glycosides (A) thus obtained amounted to 70 per cent of the total after drying in air. For further purification, it was dissolved in methyl alcohol and treated with water, added dropwise, till a faint turbidity set in On keeping the solution in an ice-chest overnight, a pale-yellow micro-crystalline solid was obtained It was insoluble in ether, very sparingly soluble in chloroform and acetone, but easily in aqueous alcohol. The Liebermann reaction was positive and similar to scillaren A, a rapidly developing carmine red which faded and changed to green. Attempts to get a more crystalline preparation failed though different mixtures of several solvents were tried The final preparation as obtained melted at 195°-200°C. (decomp), $[\alpha]_D^{28^\circ} = -101{\cdot}9^\circ$ in 75 per cent aqueous ethyl alcohol (found · C, 61·2, H, 7 4, $C_{36}H_{54}O_{14}$ requires : C, 60·8 ; H, 7·6 per cent) According to literature scillaren A melts at 270°C., $[\alpha]_D^{28^\circ} = -73{\cdot}8^\circ$

and has the formula $C_{36}H_{52}O_{13}$ requiring C, 62·4 and H, 7·5 per cent.

The water-soluble glycosides, present in the aqueous alcoholic filtrate and washings from the removal of the fraction (A), were recovered by evaporating the mixed solution under reduced pressure until a thick syrup remained This was dissolved in absolute alcohol, the solution concentrated and allowed to stand Since, however, no crystalline solid separated even after a long time, the solution was evaporated to dryness *in vacuo* and the residue left in a vacuum desiccator when an almost colourless amorphous powder was obtained as fraction (B) It was easily soluble in alcohol and water Its solubility in chloroform and acetone was more than in the case of the fraction (A) In contrast with fraction (A), it was dextrorotatory in absolute alcohol (scillaren B, dextrorotatory) It gave the Liebermann colour reaction similar to scillaren B, an initial pale red which changed to blue

Hydrolysis of the Water-insoluble Fraction (A) — 1·0 gm of the substance was dissolved in 80 c c of methyl alcohol and the solution treated with 80 c c of 4 per cent dilute sulphuric acid The mixture was heated on a water bath under reflux for half an hour. The pale-brown solid that had separated was filtered, washed first with water and then with a little methyl alcohol which removed the colour The resulting colourless product (0·51 gm) was then crystallized from a large volume of absolute alcohol Two crystalline aglucone fractions were thereby obtained, of which the less soluble fraction (A_1) melted at 230°-40°C and the more soluble (A_2) at 260°-65°C (described later).

Identification of Sugars — The aqueous alcoholic solution remaining after the separation of the aglucones was concentrated to half its volume on a water bath under reduced pressure when some more of the aglucones separated out This was filtered off, the filtrate neutralized with barium carbonate and filtered. The aqueous solution was concentrated on a water bath to a syrupy consistency. The residue was dissolved in the minimum amount of water and the solution again filtered. The clear filtrate was strongly reducing to Fehling's, when distilled with hydrochloric acid (12 per cent), the distillate had the characteristic smell of methyl furfural and gave a red colour with resorcinol in conc hydrochloric acid, indicating the presence of a methyl pentose For further characterization of the sugar (or sugars), the osazone (or osazones) was prepared as given below

The aqueous sugar solution was treated with an aqueous solution of phenyl hydrazine hydrochloride and sodium acetate containing a few drops of glacial acetic acid and the mixture kept on a boiling water bath Separation of yellow crystals commenced even after 5 min The quantity that had separated within 15 min was filtered off and crystallized from aqueous alcohol when it came out in the form of sheaves of yellow prisms melting at 205°-6°C (glucosazone) One of the component sugars should, therefore, be glucose The crystalline osazone that separated during the next half-hour was collected and recrystallized repeatedly from alcohol-acetone mixture till the melting point remained constant Yellow needles melting at 220°-21°C thus obtained were identified as phenylosazone of rhamnose The melting point recorded in literature for phenylosazone of *L*, α-rhamnose is 222°C Thus the second sugar component was found to be rhamnose

Identity of the Aglucone (A_1) with Scillaridin A — After two crystallizations from absolute alcohol, the aglucone (A_1) was obtained as beautiful refracting prisms melting at 250°-52°C (decomp), $[\alpha]_D^{25} =$ −64 8° in chloroform and ethyl alcohol (4 1) (found C, 78 3, H, 8 3, $C_{24}H_{30}O_3$ requires C, 78 7, H, 8 2 per cent) It was sparingly soluble in ether and cold alcohol but easily in chloroform By lactone titration (0 2 gm of the substance used up 5·6 c c of 0·1 N sodium hydroxide), its equivalent weight was found to be 358 ($C_{24}H_{30}O_3$ requires 366) It gave the Liebermann colour reaction just like scillaridin A and was positive to Rosenheim's test with trichloracetic acid Its identity with scillaridin A was established by close comparison with an authentic sample of the compound (m p 248°-50°C, [α] = −63 9° observed under identical conditions) and a mixture of the two did not show any depression in melting point (248°-50°C)

This identity was further confirmed by preparing iso-scillaridinic acid methyl ester as follows

0·5 gm of the substance (A_1) was dissolved in 20 c c of 0·1 N methyl alcoholic potash and the solution boiled under reflux for 1 hr on a water bath The yellow-coloured solution was cooled and acidified with ice-cold methyl alcoholic hydrochloric acid (2 1) The alcohol was evaporated under reduced pressure and to the contents water was added when a pale-yellow crystalline solid separated This was filtered, washed free from acid and dried When crystallized from methanol, it separated as thick rectangular plates melting at 173°-75°C and having $[\alpha]^{30}_{D} = -299\ 5°$ in ethyl alcohol, yield, 0 35 gm Iso-scillaridinic acid methyl ester is reported to have m p 174°-75°C, $[\alpha]^{30}_{D} = -301\ 4°$[5]

Aglucone (A_2) — The absolute alcoholic mother liquor left over after the crystallization of scillaridin A was concentrated *in vacuo* to a small bulk and allowed to stand in a well-stoppered flask After 30 days, prismatic crystals had separated These were filtered, washed with a few drops of alcohol and recrystallized once from a small quantity of absolute alcohol Colourless stout prisms (one end wedge shaped) melting at 265°-67°C were obtained (found C, 76 6, H, 8 4, $C_{26}H_{32}O_4$ requires C, 76 5, H, 7 8 per cent) A mixture of it with an authentic sample of scillaridin A sintered at 200°C and melted completely before 230°C Its colour reactions with conc sulphuric acid, and acetic anhydride and conc sulphuric acid were different from those of scillaridin A, but the Rosenheim test was positive just as with scillaridin A

Hydrolysis of the Water-soluble Fraction (*B*) — When hydrolysed with aqueous sulphuric acid (2 per cent), the fraction (B) of the total glycosides gave a crystalline aglucone melting at 227°-30°C (decomp) in a very small yield and the sugar part was identified as glucose by preparing the osazone, m p 206°C (scillaren B of Stoll *et al* gave an aglucone, m p 228°-29°C, in a very small yield and glucose)

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Chemical Examination of *Archa* (*Sonneratia acida* Linn.) — Part I: Isolation of Three Crystalline Products from the Wood

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Two colouring matters, archin, $C_{15}H_7O_5(OH)_3$, and archinin, $C_{14}H_8O_4(OH)_6$, and a colourless, crystalline, water-soluble phenolic compound, archicine, $C_{17}H_{14}O_{15}$, have been isolated from the wood of *Sonneratia acida* Linn.

SONNERATIA acida Linn (N O — *Lythraceae*, Hindi — *archa* or *orcha*) is a small tree with red flowers and orange-coloured wood. It is recommended in the indigenous system of medicine as a poultice The fermented juice of the fruit is said to be useful in cases of haemorrhage

As there is no reference in literature in regard to the chemistry of the plant, a detailed examination of the plant was undertaken in these laboratories The powdered wood yields a highly coloured extract from which two colouring matters and a white crystalline product have been isolated

They have been provisionally named as follows :

1. Archin, $C_{15}H_{10}O_5$, $C_{15}H_7O_2(OH)_3$, orange-red needles, m p 248°C , yield 2 per cent

2 Archinin, $C_{15}H_{10}O_4$, $C_{15}H_8O_2(OH)_2$, lemon-yellow plates, m p 197°C , yield 1 5 per cent.

3 Archicine, $C_{17}H_{14}O_{12}$ (provisional), water-soluble, colourless needles, m p 257°C , yield 0·05 per cent

These products were isolated by extracting the powdered wood with ether and separating the various constituents through fractionation with other solvents The initial crystallizate of the colouring matters obtained from the ethereal extracts was extracted with hot benzene in which archinin is more soluble than archin The isolation of these two products in a pure form was made possible through repeated fractional crystallization from benzene and ethyl acetate respectively Archicine was obtained from the aqueous extracts of the residue left over after the removal of the solvent from the final mother liquors of archin and archinin

Archin is optically inactive and dissolves in dilute sodium bicarbonate solution with a deep-red colouration and precipitates out unchanged on acidification of the solution It gives a reddish-brown colouration with ferric chloride, and appears to contain three hydroxyl groups, as it yields tri-acetyl and tri-benzoyl derivatives On bromination in chloroform solution in the cold, it gives a crystalline bromo-compound which analyses for a mono-bromo derivative It does not give a phenyl hydrazone

Archinin is insoluble in dilute sodium bicarbonate solution, but dissolves in dilute solutions of caustic alkalies with a red colouration and is precipitated out unchanged on acidification of the solution It is optically inactive It does not contain any methoxy group, and fails to give a phenyl hydrazone. It gives a reddish-brown colouration with ferric chloride in alcoholic solution and appears to contain two hydroxyl groups as it yields di-acetyl and di-benzoyl derivatives

Archicine readily dissolves in dilute sodium bicarbonate solution to a bluish-green solution which deepens on keeping With dilute caustic alkalies it gives a blood-red colouration. It gives an evanescent greenish-blue colouration changing to dirty green with ferric chloride in alcoholic solution

The results of further studies in the chemical constitution of these compounds will be dealt with in a subsequent communication

Experimental

2 kg of the powdered drug were soxhletted with ether The concentrated extract which showed a deposit of crystals was kept in the refrigerator for a few days, and the crude colouring matter (40 gm) which crystallized out was filtered and washed with small quantities of ether The mother liquors were purified by precipitating extraneous impurities with petroleum ether The yellowish-red clear filtrate, on concentration and cooling, yielded a second crop of the colouring matter (30 gm) The residue left over after the removal of the solvent from the final mother liquors was extracted with hot water and the aqueous solution repeatedly shaken out with ethyl acetate after saturation with sodium chloride The ethyl acetate solution on concentration and cooling yielded crude archicine The crystallizate of the colouring matter was separated into archin and archinin through extraction with hot benzene The benzene-insoluble residue mainly consisted of crude archin while the benzene solution on concentration and cooling yielded crude archinin

Archin — The crude product obtained above after repeated crystallization from ethyl acetate finally gave pure archin in the form of orange-red needles melting at 248°C It is insoluble in petrol ether, sparingly soluble in ether, and soluble in ethyl acetate, acetone and methanol in the hot Found C, 66 2 , H, 3·7 , OCH_3 (after Zeissel), nil , M W (Rast), 256 , $C_{15}H_{10}O_5$ requires C, 66 7 , H, 3 7 per cent , M W , 270

Tri-acetyl-archin, $C_{15}H_7O_2(CH_3COO)_3$ — 0 35 gm of archin was heated with 8 c c of acetic anhydride and 1 gm of fused sodium acetate on the water bath for 5 hr On dilution with water, the acetyl derivative precipitated out from the reaction mixture After repeated crystallization from ethyl acetate, it was finally obtained in the form of yellow needles melting at 197°C. , yield, 0 32 gm Found C, 63 5 , H, 4·2 , $C_{21}H_{16}O_8$ requires C, 63·6 , H, 4 2 per cent

0 1 gm of the acetyl derivative on treatment with 1 c c of concentrated sulphuric

acid and subsequent dilution gave back archin

Tribenzoyl-archin, $C_{15}H_7O_2(C_6H_5COO)_3$ — 0 35 gm of archin was dissolved in 40 c c of 10 per cent aqueous caustic potash solution, and to the cooled solution 4 c c of benzoyl chloride were added in small lots with constant shaking The benzoyl derivative which separated out as a sticky paste was extracted with ethyl acetate The ethyl acetate solution was washed with water, dried over anhydrous sodium sulphate and concentrated on the water bath The concentrated solution on cooling gave the benzoyl derivative in the form of lemon-yellow needles melting at 190°C Found C, 74 6, H 4 1 $C_{36}H_{22}O_8$ requires C, 74 2, H 4 1 per cent

Mono bromo archin, $C_{15}H_9O_5Br$ — 0 299 gm of the substance in 50 c c of dry chloroform was titrated in the cold against 5 per cent bromine solution in the same solvent Bromine was found to be in excess after the addition of only a few drops of the bromine solution 4 c c of the bromine solution were added and the reaction mixture was kept in the cold overnight when a reddish orange crystalline precipitate separated out (m p 270°C) The bromo derivative was sparingly soluble in ether and fairly soluble in acetone, ethyl acetate and alcohol in the hot On crystallization from alcohol it was obtained in the form of orange-yellow needles showing the same melting point as the initial crystallizate, yield, 0 30 gm Found C, 51 6, H 2 6 Br, 22 7 $C_{15}H_9O_5Br$ requires C 51 6, H 2 6, Br 22 9 per cent

Archinin — The crude product (m p 162°C) obtained from the benzene extract of the total colouring matter was repeatedly extracted with ether and the ether-insoluble residue melting at 167°-72°C was subjected to repeated fractional crystallization from benzene when it finally yielded pure archinin in the form of golden-yellow needles (m p 197°C) Found C, 70 9, H, 4·0, OCH_3 (Zeissel), nil, M W (Rast), 256, $C_{15}H_{10}O_4$ requires C, 70 9, H, 3 9 per cent, M W, 254

Diacetyl-archinin, $C_{15}H_8O_2\,(CH_3COO'')_2$ — 0 35 gm of archinin was heated on the water bath with 10 c c of acetic anhydride and 1 gm of fused sodium acetate for 8 hr On dilution with ether the acetyl derivative precipitated out as a reddish-yellow crystalline powder Repeated crystallization of this material from acetone yielded the diacetyl derivative as lemon-yellow silky needles melting at 206°C, yield, 0 4 gm Found C, 66 6 H, 4 5, $C_{19}H_{14}O_4$ requires C, 66 3, H 4 3 per cent

Dibenzoyl archinin, $C_{15}H_8O_2(C_6H_5COO)_2$ — 0 4 gm archinin was dissolved in 40 c c of 20 per cent aqueous potassium hydroxide and to the cooled solution 8 c c of benzoyl chloride were added in small lots with occasional cooling and constant shaking The resulting benzoylated product was extracted with ethyl acetate and the ethyl acetate solution after washing with water and drying over anhydrous sodium sulphate was freed of the solvent on the water bath The residue after a few crystallizations from ether and acetone yielded the benzoyl derivative melting at 209°C yield 0 4 gm Found C 74 0, H, 4 2 $C_{29}H_{18}O_6$ requires C, 74 2, H, 4 2 per cent

Archicine — After a few crystallizations of the crude product (m p 226°C) from ethyl acetate, archicine was finally obtained in the form of colourless broom like aggregates of needles melting at 257°C It is sparingly soluble in ether and petrol ether, soluble in water and ethyl acetate in the hot, and readily soluble in acetone, methanol and alcohol In 1 per cent alcoholic solution it showed $[\alpha]^{34}_{D} = 11\,0°$ Found C, 49 7, H, 3 5, OCH_3 (*Zeissel*), nil, $C_{17}H_{14}O_{12}$ requires C, 49 7, H, 3 4 per cent

Viscosities of Liquid Mixtures of Resinols with Mineral & Vegetable Oils

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The relation between viscosity and composition of liquid mixtures containing resinols and mineral or vegetable oils has been studied. The characteristics of the viscosity-concentration curves are attributed to the phenolic hydroxyl groups present in anacardol and bhilawanol, the principal constituents of the cashew and bhilawan shell liquids used in these studies. The viscosities of mixtures of castor oil with other vegetable oils are influenced by the presence of the hydroxyl group in ricinoleic acid.

IN the course of our investigations on the formulation of postal stamping and allied inks[1], it was noted that the addition of cashew shell liquid stabilized the dispersion of carbon black in oily vehicles, and that while it appreciably reduced the viscosity of mineral oils, it had an opposite influence on the viscosities of vegetable oils. A quantitative study of the viscosities of mixtures of resinols like cashew and bhilawan shell liquids and mineral and vegetable oils was undertaken. The results obtained are reported in this communication.

The changes in viscosities of liquid mixtures in relation to the viscosities of components have been studied by various workers[2-10]. In the present investigation, it has been found that the viscosity curves of mixtures of cashew shell liquid or bhilawan shell liquid with mineral oils of identical viscosities show minima at 40 per cent concentration of the resinol. When vegetable oils are substituted for mineral oils in these mixtures, the curves show maxima in the neighbourhood of 60 per cent concentration of the resinols. Viscosity-concentration curves of mixtures of mineral oils and vegetable oils (without the addition of resinols) show, on the other hand, no minima or maxima. Mixtures of castor oil, which contains an alcoholic hydroxyl group in its predominant constituent acid, and other common vegetable oils, show a somewhat anomalous behaviour.

Experimental

The two resinols investigated were commercial heat-expelled cashew shell liquid and solvent-extracted bhilawan shell liquid. The former consists mainly of the decarboxylation product of anacardic acid, which is a salicylic acid derivative with a $C_{15}H_{27}$ unsaturated chain, and constitutes nearly 90 per cent of the juice naturally occurring in the cashew nuts[11,12]. The solvent-extracted bhilawan shell liquid[13] consists mainly of a catechol derivative with a similar $C_{15}H_{27}$ straight side chain in position 3.

Suitable blends of mineral oils and vegetable oils were prepared. The vegetable oils were blown at 120°C to the viscosities of the resinols. These oils were mixed with the resinols in varying proportions by volume, and the viscosities of the mixtures determined by an Ostwald's viscometer at 40°C. The values in kinematic units were plotted against the concentration of the components.

1 *Cashew Shell Liquid Mineral Oils* — The viscosities of mixtures of mineral oil blends (viscosities 114·0 c.s., 113·8 c.s., and 112·5 c.s. at 40°C) with varying proportions of cashew shell liquid (viscosity 112·2 c.s. at 40°C), are given in Fig. 1. The rate of fall in viscosity decreases with increasing concentration of cashew shell liquid, a 16 per cent decrease being reached at a concentration of 40 per cent cashew shell liquid. At higher concentrations, a rise in viscosity is observed.

2 *Bhilawan Shell Liquid Mineral Oils* — Two different samples of bhilawan shell liquid were used. One sample was obtained by extracting incised nuts with low boiling petroleum ether and distilling off the solvent (finally *in vacuo*). The liquid had a viscosity of 221·6 c.s. The viscosity-concentration curve obtained with mixtures of this shell liquid and a mineral oil (viscosity 222·1 c.s) is reproduced in Fig. 2. A more viscous sample of bhilawan shell liquid

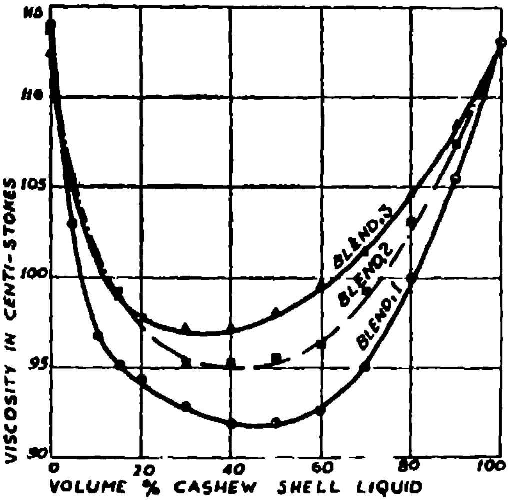

FIG 1 — CASHEW SHELL LIQUID MINERAL OILS

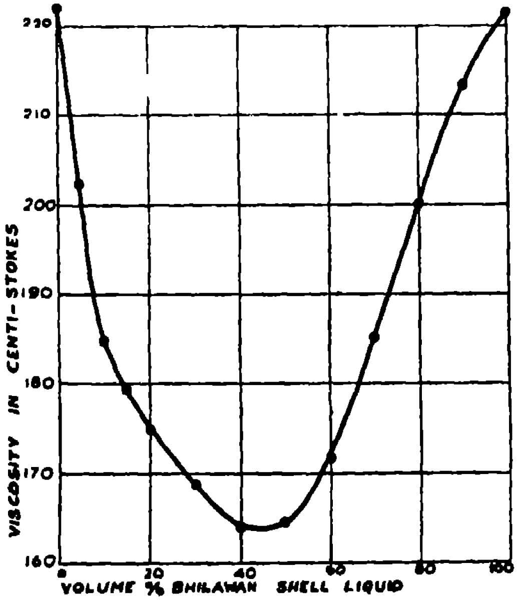

FIG 2 — BHILAWAN SHELL LIQUID MINERAL OIL

(viscosity 369 6 c s) was employed in the second set of experiments The viscosities and specific gravities of mixtures of this liquid with mineral oil (viscosity 368·6 c s) are represented in Fig 3

3 *Cashew Shell Liquid Vegetable Oils* — Groundnut and mustard oils were blown at 120°C to viscosities 103·4 c s and 101·5 c s respectively The cashew shell liquid used had a viscosity of 102·8 c s The viscosities of mixtures of a vegetable oil blend consisting of castor oil, 58 parts ; groundnut oil, 42 parts, viscosity 112·8 c s., and cashew shell liquid (viscosity 113 2 c s) were determined The results are represented graphically in Fig 4

In contrast to the results obtained with mineral oils, the viscosities increase with increasing concentration of the resinol to a maximum value and then fall The maximum in all the cases studied is reached at a concentration of 60 per cent cashew shell liquid

4 *Bhilawan Shell Liquid Vegetable Oil* — Mustard oil blown at 120°C (viscosity

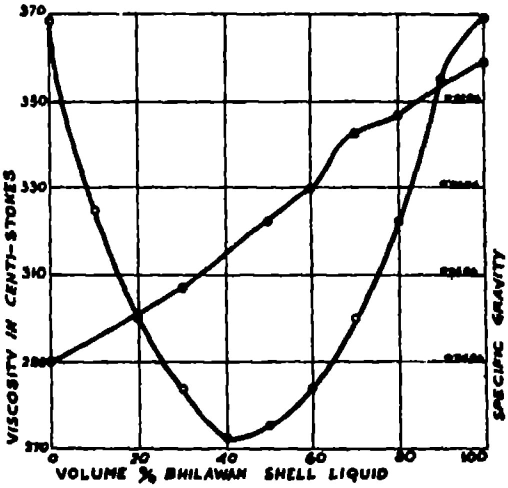

FIG 3 — BHILAWAN SHELL LIQUID MINERAL OIL

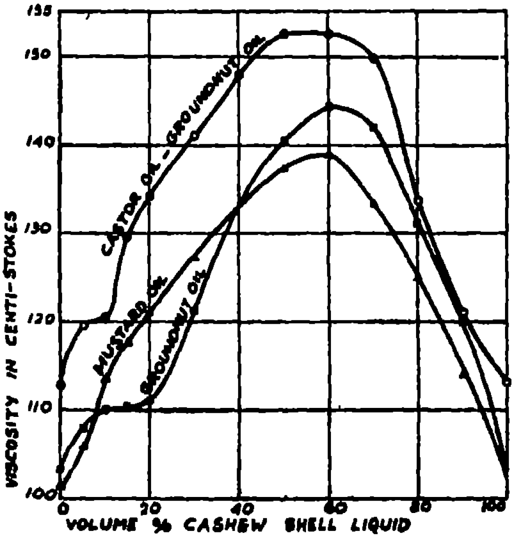

FIG 4 — CASHEW SHELL LIQUID VEGETABLE OILS.

385·9 c.s.) and bhilawan shell liquid (viscosity 379·1 c s) were employed The viscosity-concentration curve (FIG 5) shows a maximum at a concentration of 60 per cent bhilawan shell liquid, the maximum increase in viscosity being about 69·5 per cent The sp gr curve does not show any similarity to the viscosity-concentration curve

5. *Mixtures of Mineral Oils & of Vegetable Oils* — The viscosity concentration curve of mixtures of two mineral oils of identical viscosity is not a straight line (FIG 6) This is also true of mixtures of vegetable oils. Blown groundnut oil was mixed with mustard oil of approximately the same viscosity in different proportions and the viscosities of the mixtures determined The results are represented in Fig 7

6 *Castor Oil Mustard Oil* — The viscosities of mixtures of castor oil (viscosity 281 5 c s) and blown mustard oil (viscosity 285 9 c s) are shown graphically in Fig 8. The viscosity-concentration curve shows 2 minima at 30 and 60 per cent concentrations of castor oil

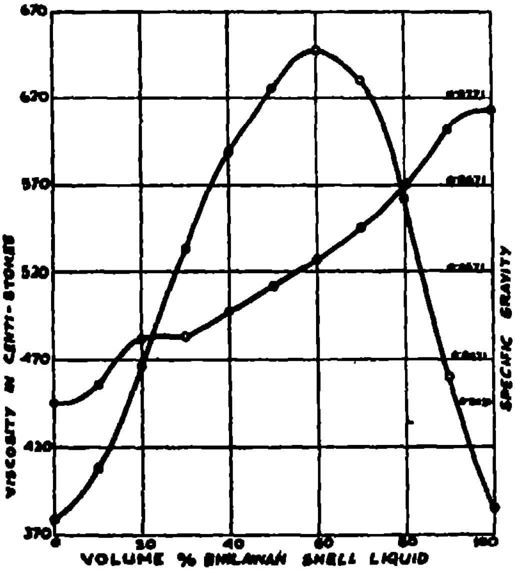

FIG 5 — BHILAWAN SHELL LIQUID MUSTARD OIL

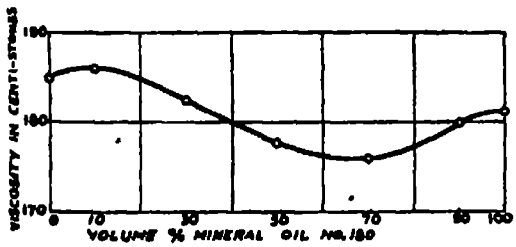

FIG 6 — MINERAL OIL MINERAL OIL

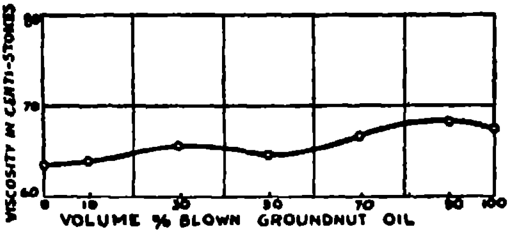

FIG 7 — GROUNDNUT OIL MUSTARD OIL

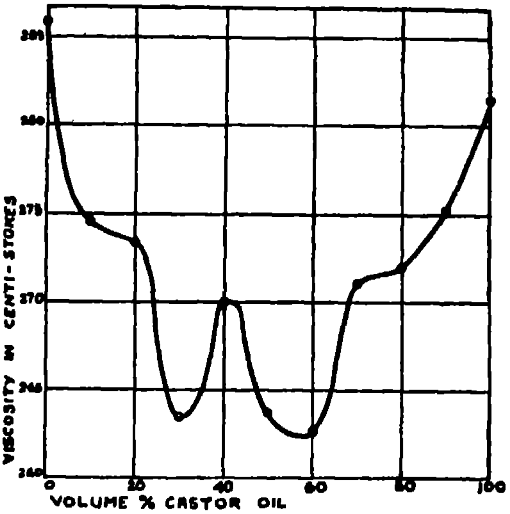

FIG 8 — CASTOR OIL MUSTARD OIL

Discussion

The viscosity-concentration curves of resinols with mineral oil blends show minima at the same percentage concentration of the components The decrease in viscosity in these cases can be attributed to the presence of phenolic hydroxyl groups in the shell liquids Dunstan and Thole[5] have pointed out that liquids containing such groups are highly associated in the pure state When dissolved in neutral solvents, they are apparently dispersed

The viscosity curves of mixtures of resinols with vegetable oils show maxima at 60 per cent concentration of resinols As both components contain polar groupings and are unsaturated in character, the formation of intermolecular aggregates is favoured This accounts for the observed rise in viscosities

These conclusions are supported by the observation that the variation in the viscosities of mixtures containing bhilawan shell liquid is nearly two times that observed in mixtures containing cashew shell liquid The former contains bhilawanol with 2 phenolic groups, while anacardol present in cashew shell liquid has but one phenolic group

Mixtures of mineral oils and of vegetable oils (FIGS 6 and 7) behave differently The behaviour of vegetable oil mixtures containing castor oil is somewhat different (FIG 8) Further work is necessary to explain the variations observed, but the presence of the polar grouping in ricinoleic acid, the main constituent acid of castor oil, suggests an explanation

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Investigation on Indian Radioactive Minerals : II—Allanite

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The formula $(Ca, Ce)_2(Al, Fe, Mg)_3 Si_3 (O, OH)_{13}$ has been assigned to the radioactive mineral "allanite" on the basis of quantitative chemical analysis. The geological age of the mineral has also been determined.

ALLANITE or orthit is widely distributed in nature, occurring in pegmatitic veins in granites, syenites, many acid volcanic and hypabyssal rocks, in limestone and magnetic iron ores The composition of the mineral is highly variable, and to explain this variation, Goldschmidt suggested that most orthits are similar to solid solutions. The mineral occurs in India in large quantities in Bihar, Tipper collected the mineral from Sankara mica mine, Nellore district, Madras In this laboratory[1], a specimen of the mineral from Bahea, two miles east of Tatisilwai on the B N Ry, was previously analysed and its geological age determined With a view to determine the chemical composition, a complete chemical analysis of a specimen collected from the same locality was undertaken

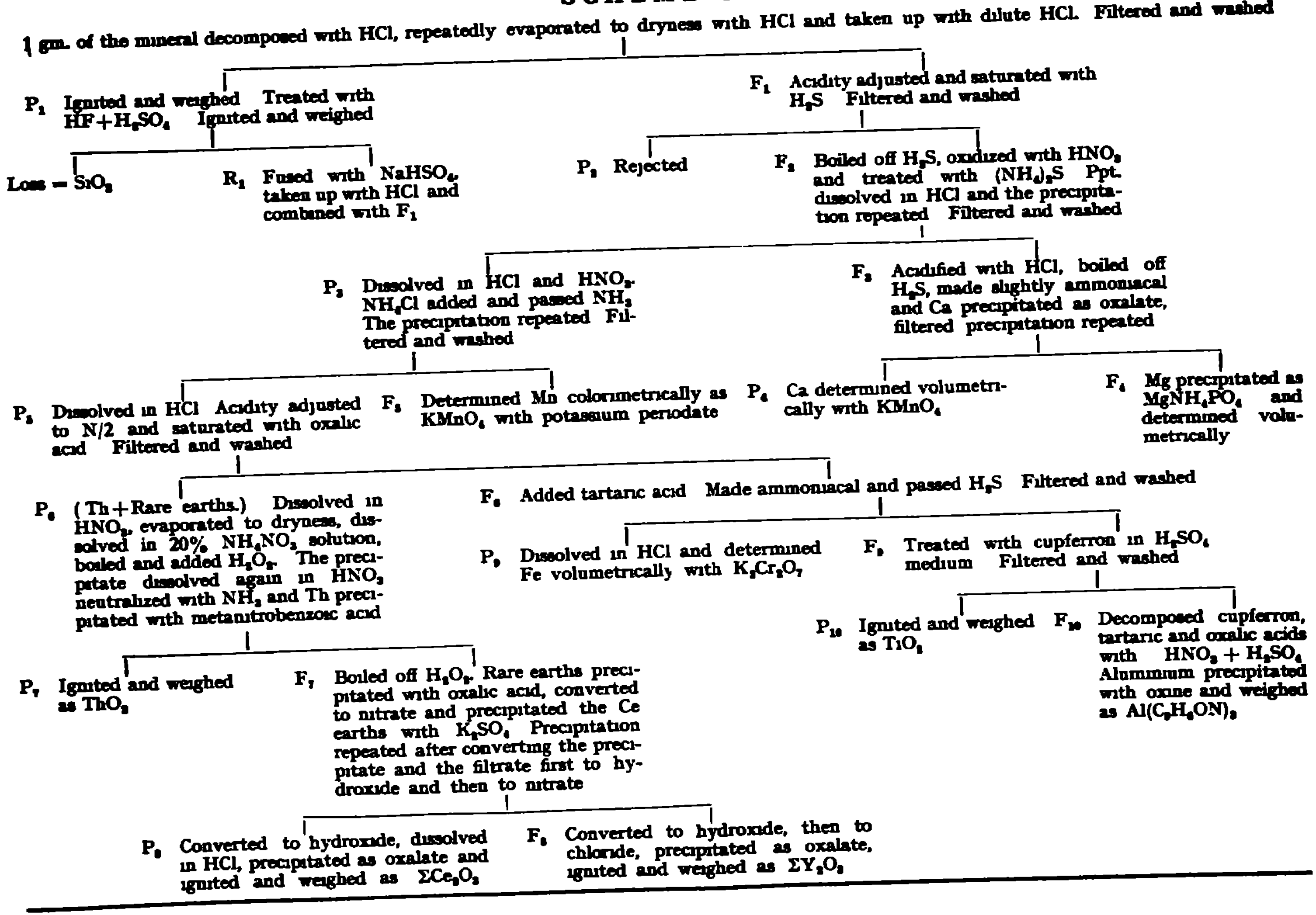
Method of Analysis

The sample was crushed to small fragments, selected pieces were purified by repeated decantation with water and treatment with very dilute nitric acid and finally washing with distilled water The purified mineral was powdered and passed through 200-mesh The method of analysis is given in Scheme I

In a separate portion of the sample, phosphorus and manganese were estimated following the procedure given in Scheme II

For the determination of ferrous iron, small pieces of the mineral were decomposed by heating with hydrochloric and hydrofluoric acids in a current of carbon dioxide and cooled Boric acid was added and the solution titrated with standard potassium dichromate solution with diphenylamine sulphonate as internal indicator

SCHEME I



1 gm. of the mineral decomposed with HCl, repeatedly evaporated to dryness with HCl and taken up with dilute HCl. Filtered and washed

P_1 Ignited and weighed Treated with $HF+H_2SO_4$ Ignited and weighed

Loss = SiO_2

R_1 Fused with $NaHSO_4$, taken up with HCl and combined with F_1

F_1 Acidity adjusted and saturated with H_2S Filtered and washed

P_2 Rejected

F_2 Boiled off H_2S, oxidized with HNO_3 and treated with $(NH_4)_2S$ Ppt. dissolved in HCl and the precipitation repeated Filtered and washed

P_3 Dissolved in HCl and HNO_3. NH_4Cl added and passed NH_3 The precipitation repeated Filtered and washed

F_3 Acidified with HCl, boiled off H_2S, made slightly ammoniacal and Ca precipitated as oxalate, filtered precipitation repeated

P_5 Dissolved in HCl Acidity adjusted to N/2 and saturated with oxalic acid Filtered and washed

F_5 Determined Mn colorimetrically as $KMnO_4$ with potassium periodate

P_4 Ca determined volumetrically with $KMnO_4$

F_4 Mg precipitated as $MgNH_4PO_4$ and determined volumetrically

P_6 (Th + Rare earths.) Dissolved in HNO_3, evaporated to dryness, dissolved in 20% NH_4NO_3 solution, boiled and added H_2O_2. The precipitate dissolved again in HNO_3 neutralized with NH_3 and Th precipitated with metanitrobenzoic acid

F_6 Added tartaric acid Made ammoniacal and passed H_2S Filtered and washed

P_9 Dissolved in HCl and determined Fe volumetrically with $K_2Cr_2O_7$

F_9 Treated with cupferron in H_2SO_4 medium Filtered and washed

P_{10} Ignited and weighed as TiO_2

F_{10} Decomposed cupferron, tartaric and oxalic acids with $HNO_3 + H_2SO_4$ Aluminium precipitated with oxine and weighed as $Al(C_9H_6ON)_3$

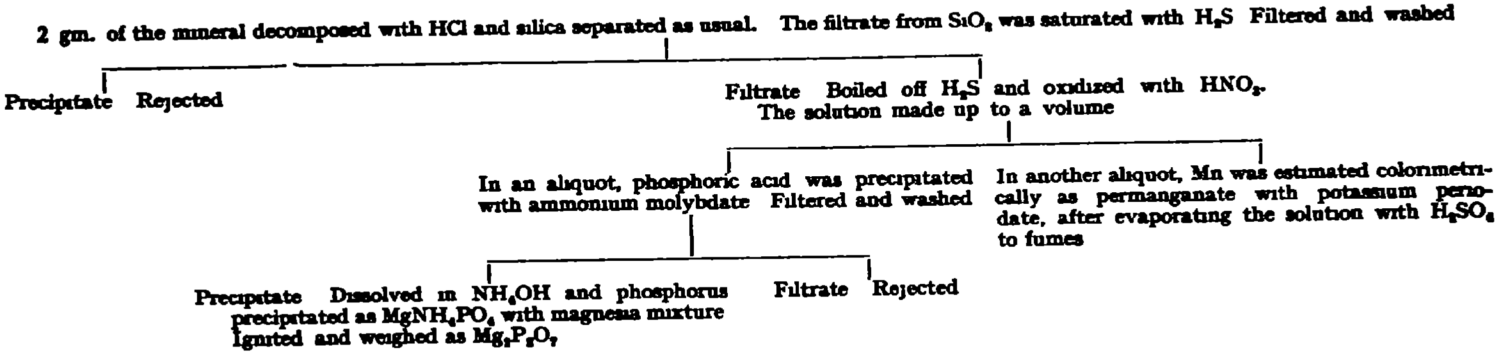
P_7 Ignited and weighed as ThO_2

F_7 Boiled off H_2O_2. Rare earths precipitated with oxalic acid, converted to nitrate and precipitated the Ce earths with K_2SO_4 Precipitation repeated after converting the precipitate and the filtrate first to hydroxide and then to nitrate

P_8 Converted to hydroxide, dissolved in HCl, precipitated as oxalate and ignited and weighed as ΣCe_2O_3

F_8 Converted to hydroxide, then to chloride, precipitated as oxalate, ignited and weighed as ΣY_2O_3

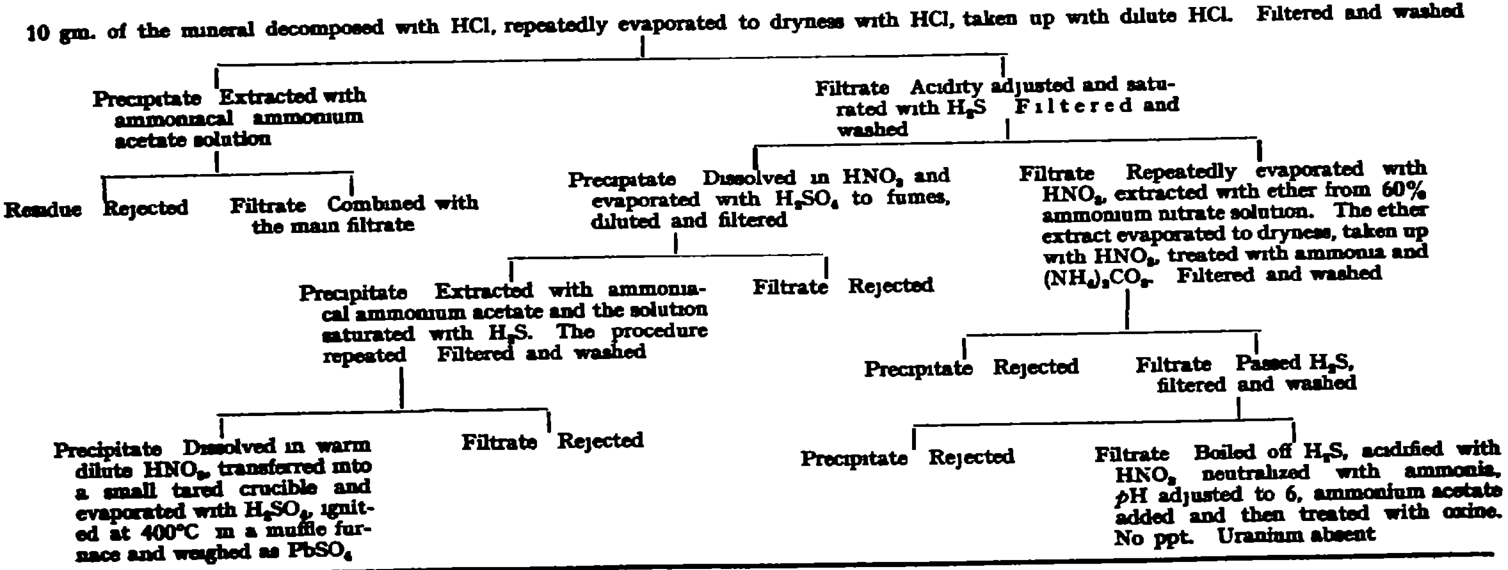
SCHEME II



2 gm. of the mineral decomposed with HCl and silica separated as usual. The filtrate from SiO_2 was saturated with H_2S Filtered and washed

- **Precipitate** Rejected
- **Filtrate** Boiled off H_2S and oxidized with HNO_3. The solution made up to a volume
  - In an aliquot, phosphoric acid was precipitated with ammonium molybdate Filtered and washed
    - **Precipitate** Dissolved in NH_4OH and phosphorus precipitated as $MgNH_4PO_4$ with magnesia mixture ignited and weighed as $Mg_2P_2O_7$
    - **Filtrate** Rejected
  - In another aliquot, Mn was estimated colorimetrically as permanganate with potassium periodate, after evaporating the solution with H_2SO_4 to fumes

SCHEME III



10 gm. of the mineral decomposed with HCl, repeatedly evaporated to dryness with HCl, taken up with dilute HCl. Filtered and washed

- **Precipitate** Extracted with ammoniacal ammonium acetate solution
  - **Residue** Rejected
  - **Filtrate** Combined with the main filtrate
- **Filtrate** Acidity adjusted and saturated with H_2S Filtered and washed
  - **Precipitate** Dissolved in HNO_3 and evaporated with H_2SO_4 to fumes, diluted and filtered
    - **Precipitate** Extracted with ammoniacal ammonium acetate and the solution saturated with H_2S. The procedure repeated Filtered and washed
      - **Precipitate** Dissolved in warm dilute HNO_3, transferred into a small tared crucible and evaporated with H_2SO_4, ignited at 400°C in a muffle furnace and weighed as $PbSO_4$
      - **Filtrate** Rejected
    - **Filtrate** Rejected
  - **Filtrate** Repeatedly evaporated with HNO_3, extracted with ether from 60% ammonium nitrate solution. The ether extract evaporated to dryness, taken up with HNO_3, treated with ammonia and $(NH_4)_2CO_3$. Filtered and washed
    - **Precipitate** Rejected
    - **Filtrate** Passed H_2S, filtered and washed
      - **Precipitate** Rejected
      - **Filtrate** Boiled off H_2S, acidified with HNO_3 neutralized with ammonia, *p*H adjusted to 6, ammonium acetate added and then treated with oxine. No ppt. Uranium absent

As the lead and uranium contents of the mineral were expected to be very low, portions as large as 10 gm were used for their determinations An outline of the procedure is described in Scheme III

The water of constitution of the mineral was determined by Brush and Penfield's method[3]

Cerium was estimated in the solution of the cerium earths by oxidation with potassium persulphate in presence of silver nitrate in 5 per cent H_2SO_4 medium and titrating the yellow solution with standard ferrous ammonium sulphate solution using *o*-phenanthroline-ferrous complex as indicator, after the decomposition of excess persulphate

For the determination of praseodymium, neodymium, samarium and lanthanum, the rare earths were obtained as oxalate, the cerium earth group was separated by the double sulphate method From the cerium earths, cerium was precipitated as ceric hydroxide by zinc oxide method, the bulk of zinc and manganese were then separated from the rare earths by double precipitation of the rare earth hydroxides with ammonium chloride and ammonia The remaining zinc was removed by H_2S in monochloro-acetic acid and sodium acetate medium The rare earths thus freed from cerium, zinc and manganese were precipitated as oxalate and converted to nitrate Pr, Nd and Sm were estimated in the nitrate solution by measuring the transmittancies of the solution with a photo-electric colorimeter Transmittancy-concentration curves were obtained for the individual rare earths at wavelengths where there was a maximum absorption free from interference The contents of the rare earth fractions in the mineral were determined from the logarithmic transmittancy-concentration curves The value of lanthanum was obtained by difference

A duplicate analysis of the mineral was carried out and the mean values are given in Tables I and II.

Chemical Formula — From time to time various formulae had been given to the mineral Groth regarded it as a basic salt, $R'''_2(OH)\ R''_2\ Si_3O_{12}$ of the acid $H_4Si_3O_{12}$ Marble[4] considered it to be a basic orthosilicate similar to epidote but with Ca partly replaced by ferrous iron and manganese, aluminium and ferric iron partly replaced by the cerium earth metals, Ce, Di, La, and in small amounts by those of the yttrium earth group, Y, Gd, etc Takuba and Ukawa[4] gave a formula, $Ca_2(AlOH)\ (Al, Ce, Fe)_2\ (SiO_4)_3$ A similar formula, $(FeOH)\ (Ca, Mg, Mn, Fe'', Sn, Ti)_2\ (Al, Fe''', R\ E)_2Si_3O_{12}$ had also been given by other workers On the basis of isomorphous replacement of ions having ionic radii of the same order, the formula of a fresh orthit was represented by Machatschki[6] as $(Ca, Ce)_2\ (Al, Fe, Mg)_3\ Si_3(O, OH)_{13}$ Our analysis agrees with the above formula, where rare earths having ionic radii 1 1Å-1·3Å have replaced calcium of ionic radius 1·06Å and not aluminium (0 57Å)

TABLE I—ANALYSIS OF ALLANITE FROM BAHEA

	%
SiO_2	33 27
CaO	14 99
MgO	0 13
FeO	8 95
Fe_2O_3	5 95
Al_2O_3	16 98
ΣCe_2O_3	16 25
ΣY_2O_3	0 3
ThO_2	0 63
TiO_2	0 32
MnO	0 35
P_2O_5	0 15
K_2O	0 16
Na_2O	0 14
PbO	0 02
U_3O_8	0 00
H_2O	0 95
Total	99 44
Pb ratio	0 12

TABLE II—ANALYSIS OF CERITE EARTHS

	%
Ce_2O_3	6 8
Nd_2O_3	3 6
Pr_2O_3	2 5
Sm_2O_3	2 1
La_2O_3	1 3

Age of the Mineral

Several determinations of lead, uranium and thorium gave almost identical values The geological age of the mineral was calculated from the mean values of lead, uranium and thorium by Holmes and Lawson's modified formula

$$\text{Age} = \frac{\text{Pb}}{\text{U} + 0{\cdot}38\,\text{Th}} \times 7400\left(1 - \frac{x}{2} + \frac{x^2}{3}\right)$$

$$\text{where X} = 1\ 155 \times \frac{\text{Pb}}{\text{U} + 0\ 38\ \text{Th}}$$

The age of the mineral was found to be 830 million years, showing that the mineral belongs to the upper Pre-cambrian era.

Our grateful thanks are due to Prof P. B Sarkar for his keen interest in this work and to the Council of Scientific & Industrial Research, for financial help

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Studies in the Fermentation of Carbohydrates by Yeasts — Part I (*Saccharomyces*)

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The fermentation of 22 carbohydrates by 10 species of *Saccharomyces* from the National Collection of Type Cultures has been investigated The results of these studies have been tabulated None of the yeasts ferment arabinose, xylose and rhamnose, lactose, glycogen, starch, inulin, dextrin and glycogen. All the yeasts ferment glucose, fructose, mannose, sucrose and maltose. Most of these ferment galactose Raffinose is partly fermented by all. Only a few of the yeasts ferment α-methyl glucoside and β-methyl glucoside.

IN a number of genera of yeasts, the species are identified by their ability to ferment particular sugars While the pentoses are not generally fermented by yeasts, the mono-, di- and tri-hexoses are readily fermented

The fermentation of raffinose occupies a special place in Stelling-Dekker's system of classification[1] Some yeasts split this tri-saccharide to fructose and melibiose, fermenting the fructose, i e "two-thirds of raffinose" Other yeasts completely hydrolyse raffinose to its component monosaccharides and are said to ferment raffinose completely This procedure provides a means of classifying yeasts

According to Mrak and Phaff[2], the fermentation of trehalose was always apparent in Durham tubes but not always in Einhorn tubes even after shaking Bouthilet and co-workers[3] have shown that the fermentation of trehalose is significant from the taxonomic aspect.

Skinner[4] used melibiose fermentability for classifying yeasts

Kluyver formulated certain generalizations concerning sugar fermentations by yeasts, which were restated by Stelling-Dekker and are referred to by Langeron and Guerra as the Kluyver-Dekker laws (i) a yeast which cannot ferment glucose cannot ferment any other sugar, (ii) a yeast which can ferment glucose can also ferment fructose and mannose, and (iii) a yeast cannot ferment both lactose and maltose

These broad generalizations have many exceptions among yeasts, and today we know of yeasts which can ferment both lactose and maltose More recently the work of Gottschalk[5] has drawn attention to the problem of "direct" fermentation of di-saccharides by yeasts The work of Winge and Roberts[6] indicates that the fermentative ability of yeasts is determined by single genes which behave in accordance with the principles of Mendelian segregation and that genes of different strengths are involved for each enzyme

Lindegren, Lindegren and Spiegelman[7] have built up breeding stocks of yeasts which are differentiated by their ability to ferment galactose, maltose, sucrose, melibiose, raffinose and α-methyl-glucoside Many combinations of gene-controlled fermentative abilities, which have not been hitherto described, have been produced by hybridization The criteria of gene control is based on the fact that when a large number of tetrads are isolated from a hybrid, two cultures from each tetrad are fermenters and two are non-fermenters. These workers have demonstrated the rôle of adaptative enzymes in *Saccharomyces cerevisiae* which ferments galactose and *Saccharomyces carlsbergensis* which ferments melibiose.

The investigations in this laboratory were initiated to study the sugar fermentation of yeasts maintained in the National Collection of Type Cultures The following carbohydrates were tested

Mono-saccharides — Arabinose, rhamnose, xylose, glucose, fructose, galactose and mannose

Di-saccharides — Lactose, sucrose and maltose

Poly-saccharides — Raffinose, melizitose, starch, inulin, dextrin and glycogen

Alcohols — Mannitol and dulcitol

Glucosides — Amygdalin, α-methyl-glucoside, β-methyl-glucoside and salicin

Materials & Methods — The yeast strains from the National Collection of Type Cultures were plated out (dilution method) Well-developed colonies were marked and transferred on to wort-agar slants Inocula were prepared by transferring a loop of yeast to normal saline, washing thrice and centrifuging and resuspending it in saline The turbidity was kept constant for each organism and inocula amounting to one-tenth the media were used

Media — The media were those of Lindegren and Spiegelman, consisting of 2 per cent desired carbohydrate plus the following

	gm
Autolysed yeast extract	. 2
Peptone (Difco-Bacto)	... 3
KH_2PO_4	. 2
$MgSO_4 \cdot 7H_2O$	0·25
Calcium chloride	0·13
Sodium lactate	1 c c of 5 per cent solution

*p*H 4 5 to 4·8, total volume, 1,000 c c

The cultures were inoculated into 2 5 c c media contained in test-tubes (75 mm × 10 mm) Each test-tube contained an inverted insert for gas (25 mm × 5 mm) The tubes were incubated at 28°C and the gas evolved was read at the end of 24 hr by measuring the length of the gas column in the insert The results are recorded in Table I

Conclusions — Certain conclusions can be drawn from the recorded results for fermentation and gas formation

1 None of the yeasts examined fermented arabinose, xylose and rhamnose According to the literature *Saccharomyces thermantitolum* ferments arabinose and xylose, Lindner's *Saccharomyces ludwigii* is also reported to ferment the pentoses

2 All the yeasts ferment, to an almost equal degree, glucose, fructose, galactose and mannose, showing certain common enzyme systems

TABLE I — FERMENTATION OF CARBOHYDRATES BY *SACCHAROMYCES*

CARBOHYDRATE OR ITS DERIVATIVE	N.C.T.C 3007	N C T C 3006	N.C.T.C. 3013	N C T C 3036	N.C.T.C. 3058	N C T C 3059	N C T C 3060	N C T C 3061	N C T C 3062	N C T C 3063
Mono-saccharides										
Arabinose	—	—	—	—	—	—	—	—	—	—
Rhamnose	—	—	—	—	—	—	—	—	—	—
Xylose	—	—	—	—	—	—	—	—	—	—
Glucose	++++	+++	++++	+++	++++	+++	++++	+++	++++	++++
Fructose	+++	++++	++++	++++	++++	+++	++++	++++	++++	++++
Galactose	+++	++++	+++	+++	++++	++++	++++	++++	++++	++++
Mannose	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
Di-saccharides										
Lactose	—	—	—	—	—	—	—	—	—	—
Sucrose	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
Maltose	++++	++++	++++	++++	++++	++++	++++	++++	++++	++++
Poly-saccharides										
Raffinose	++	++	++	++	++	++	++	++	++++	++
Melizitose	—	—	—	—	—	—	—	—	+++	—
Starch	—	—	—	—	—	—	—	—	—	—
Inulin	—	—	—	—	—	—	—	—	—	—
Dextrin	—	—	—	—	—	—	—	—	—	—
Glycogen	—	—	—	—	—	—	—	—	—	—
Alcohols										
Mannitol	—	—	—	—	—	—	—	—	—	—
Dulcitol	—	—	—	—	—	—	—	—	—	—
Glucosides										
Amygdalin	—	—	—	—	—	—	—	—	—	—
α-methyl glucoside	—	—	—	—	—	—	—	—	+++	—
β-methyl-glucoside	—	—	—	—	+	—	—	+	+	+
Salicin	—	—	—	—	+++	—	—	—	—	+++

—, no fermentation, +, 0 5 cm of gas formation, ++, 1 0 cm of gas formation, +++, 1 5 cm of gas formation, ++++, 2 0 cm of gas formation

3 Among the di-saccharides studied, lactose is not fermented by any of the yeasts , sucrose and maltose are vigorously fermented

4 Of the poly-saccharides, only raffinose is generally fermented (in varying degrees) and only *Saccharomyces carlsbergensis* (N C T C 3062) completely ferments it The partial fermentation is due to the fructose fraction being fermented, the melibiose remaining unfermented N C T C 3062 is a melibiose fermenter also

5 The yeasts do not act upon glycogen Glycogenase is an intracellular enzyme and glycogen is not able to pass through the cell membrane

6 None of the yeasts examined ferment starch, inulin and dextrin Previous workers have reported that *Saccharomyces exigus*, *Saccharomyces acetosthylicus*, *Schizo saccharomyces pombe* and *Schizo saccharomyces octosporus* ferment starch

7 In the case of glucosides, Fisher and Thierfelder have shown that some yeasts are able to split α-methyl-glucoside into methyl alcohol and glucose Among such yeasts are *Saccharomyces octosporus*, *Saccharomyces pombe*, *Saccharomyces mellaci*, the yeasts of Logos, the yeast of Frohberg and certain yeasts of Saaz Among the yeasts studied by us, *Saccharomyces carlsbergensis* (N C T.C. 3062) ferments α-methyl-glucoside and *Saccharomyces* (N C T C 3063) ferments salicin

8 Hency and Auld have shown that emulsin exists in yeasts which act upon β-methyl-glucoside Among the yeasts studied by us, N C T C 3061, N C T C 3062 and N C T C 3063 ferment β-methyl-glucoside feebly, and at the end of nearly a week

Our grateful thanks are due to Mr M Sreenivasaya for his guidance and to the Council of Scientific & Industrial Research for financing a research scheme of which this work forms a part Our sincere thanks are also due to the Director, Indian Institute of Science, Bangalore, for providing facilities for this investigation and for his kind interest in this work

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Studies on Shark Liver Oil : III — Deodorization

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The odour of shark liver oil is reduced by refluxing up the oil dissolved in absolute alcohol or propylene glycol with skim-milk powder or gum tragacanth. Solvent fractionation of the liver oil with groundnut oil effects a quantitative extraction of vitamin A, and the solution thus obtained is nearly free from fishy odour The groundnut oil extract has been subjected to cyclic distillation to obtain vitamin A concentrates

THE higher vitamin A potency of shark liver oil as compared to cod liver oil is offset by its more offensive smell, and deodorization has become a vital problem of the shark liver oil industry Concentration of the vitamin by saponification[1] and cyclic distillation[2] effect only partial deodorization Other processes involving neither of these procedures have been suggested, and because of their simplicity in operation as well as low cost, they merit study

The use of dried tomato pulp[3], or other vegetable meal such as cotton seed, corn gluten or soya bean[4], skimmed milk and butter milk powders, cheese, dried milk whey or powdered whole milk[5], activated phosphates of multivalent metals in non-polar solvents[6], etc , have been advocated as deodorising agents Their use may be combined with other well-known refining processes More recently fractionation and deodorization of fish liver oils have been brought about by the use of solvents[7 10] Deodorization procedures by deaeration at high temperatures and in vacuum have also been covered by patents[11]

The literature in respect of these processes has not been accessible, the results claimed appeared to be well worth examination A few trials were undertaken in our laboratories on the deodorization of shark liver oil and the results obtained are presented in this paper

Experimental

Deodorization by Adsorbents

1 *Dried Skim-milk Powder* (*cml*) — 50 gm of shark liver oil were dissolved in 50 c c of solvent (abs alcohol, propylene glycol, carbon tetrachloride, benzene, acetone or petroleum ether) in a 250 c c round-bottom flask by gentle warming 1 gm of dried skim-milk powder was added and the contents stirred up The mixture was refluxed for 2 hr over a water bath at 80°C in an atmosphere of carbon dioxide The contents of the flask were then cooled and the oil filtered through a cotton plug The solvent was distilled off under vacuum The results obtained with alcohol and propylene glycol as solvents were satisfactory In other cases, the oil retained the residual odour of the respective solvents, this being especially marked with petroleum ether The loss in vitamin A was *c* 1 per cent in all cases

2 *Gum Tragacanth* — The procedure was similar to that with (1) above The product obtained, using alcohol as solvent, was as good as that with milk powder Loss in vitamin A was *c* 0 5 per cent

3 *Formaldehyde Treatment* — If used alone as in (1), formaldehyde toned down the fishy odour, but it imparted to the oil its own characteristic irritating odour which could not be wholly eliminated by treatment with dried skim-milk powder Vitamin A loss was *c* 1·5 per cent.

4. *Molasses* — Molasses and the liver oil (1 · 1) were mixed up by warming The mixture was heated for 2 hr over a water bath at 80°C in an atmosphere of carbon dioxide The flask was allowed to cool, and the oil decanted off The odour of the oil was masked considerably The oil had a brown colour, which could be removed by shaking with hot water, but this treatment resulted in the reappearance of the fishy odour Vitamin A loss was *c* 2 25 per cent

5 *Hot Water Treatment or Steaming* — Boiling water was mixed with an equal volume of oil, emulsification being prevented by adding a few drops of alcohol and some common salt The washing was repeated, and the oil after three washings was dehydrated with anhydrous sodium sulphate There was a slight improvement in the fishy odour Vitamin A loss was *c* 3 per cent

Passing steam into the oil effected a slight improvement at the end of 2 hr Steaming under reduced pressure obviated emulsion formation Deodorization was slight Loss of vitamin A was *c* 5 per cent

6 *Soured Milk* (*Curd*) — Fresh curd was mixed with the liver oil in equal proportions In a few trials alcohol also was used as solvent for the oil The procedure was the same as in (1) Emulsification was observed in all cases The oil which separated out on standing was cloudy, and there was little improvement in the odour Vitamin A loss was *c* 3 per cent

Mathew *et al*[12] have observed that oil deodorized by agitation with fermenting milk or toddy remained bland for several months

7 *Tomato Pulp & Residue from Germinated Groundnuts* — The residue from sliced tomatoes after pressing out the juice was dried in vacuum and powdered The powder (2 gm) was mixed with the oil (100 c c) and shaken in a mechanical shaker There was little improvement in the odour Refluxing with absolute alcohol brought about a noticeable improvement, but the oil was coloured brown Loss of vitamin A was *c* 0 5 per cent.

Similar results were obtained with the press meal from sprouted groundnuts, the separated oil was cloudy

Solvent Extraction

The solvents used were refined groundnut oil, paraffin oil, alcohol, acetone and propyl alcohol in the proportion of 1 part of oil to 1, 2 and 3 parts of solvent The oil was shaken up with the solvent and the mixture frozen The solvent was recovered by fractional thawing[13] Where the rate of oil to solvent was 1 1, the separation of solvent layer was difficult and the extraction of vitamin A was incomplete The separation was satisfactory when the proportion of oil to solvent was 1 3 Among the solvents examined, groundnut oil gave the best results Absolute alcohol and propyl alcohol extracted 9 per cent and 11 per cent respectively of the vitamin A ester of the oil; separation of solvent from mixtures containing acetone or paraffin oil was difficult

Groundnut Oil — 1 part of shark liver oil was mixed by warming with 3 parts of groundnut oil, and the mixture frozen by storage in an ice chest for 24 hr The groundnut oil phase could be separated by controlled thawing, the frozen mass being thawed till about 75 per cent of the mass was in the liquid state The groundnut oil layer was separated by decantation and cold pressing The oil solvent extracts vitamin A quantitatively, and the solution had less of the fishy odour The results obtained are summarized in Table I

TABLE I — SOLVENT EXTRACTION OF VITAMIN A FROM SHARK LIVER OIL

QUANTITIES	SAMPLE 1	SAMPLE 2
Shark liver oil taken, gm	175	180
Potency, I U /gm	28 000	15,000
Total potency, I U	49,00 000	27,00 000
Groundnut oil added, gm	525	540
Groundnut oil phase recovered, gm	510	530
Potency, I U /gm	9 625	5,000
Total potency, I U	49,08,750	26,50,000

The concentration of vitamin A in the extract, which had a bland taste, was only about one-third of that in the original oil. This is not a serious drawback as, in practice, most brands of shark liver oil are marketed after dilution with inert vegetable oils. If the potency of the original oil is of the order of 30,000-40,000 I U /gm, the diluted product will still correspond in strength to imported vitamin A concentrates whose potencies range from 10,000 to 15,000 I U /gm But if the original shark liver oil has a potency of 20,000 I U /gm, the final product will have a strength of only 6,000-8,000 I U /gm 1 gm of this product will be sufficient to meet the daily requirement (5,000 I U) of an adult The method has much to recommend itself for practical adoption

Cyclic Distillation of Groundnut Oil Solution of Vitamin A — It has been observed[3] that cyclic distillation yields a product which is comparatively less odorous than the starting oil Further, the efficiency of fractionation is likely to be higher if groundnut oil carrying the vitamin A is subjected to cyclic distillation rather than the original shark liver oil Several distillations of the groundnut oil solution of vitamin A were carried out Typical results are presented in Table II

The groundnut oil solution of the vitamin A ester on subsequent cyclization in the molecular still resulted not only in better recovery of vitamin A at the temperature range 180°-200°C than that obtained with the original shark liver oil, but also in more complete removal of the residual odour. That the efficiency of distillation of vitamin A is considerably increased by this procedure will be clear from Table III.

TABLE II — MOLECULAR DISTILLATION OF GROUNDNUT OIL SOLUTION OF VITAMIN A

FRACTION	CYCLE	TIME min	COLOUR OF DISTILLATE	YIELD gm	POTENCY I U /gm	TOTAL POTENCY I U	TOTAL POTENCY, I U, FOR EACH STAGE
Sample 1							
Undistilled oil			Reddish brown	500	9,625	48,12,500	48,12,500
Below 180°C	1st	40	Yellowish dull brown	5 7	39,000	2 22,300	
	2nd	40	do	3 1	60,000	1,86,500	4,08,800
180° 200°C	1st	40	Brownish yellow	5 0	3,22,500	16 12,500	
	2nd	39	Yellow	3 5	3,26,225	11,41,787	
	3rd	39	do	2 0	3,22,500	6,45,000	33,99,287
200° 20°C	1st	38	Pale yellow	15 8	40,500	6,39,900	
	2nd	37	do	8 2	30,000	2,46,000	8,85,900
220° 40°C	1st	36	Very faint yellow	43 5	6,225	2,70,787	2,70,787
Residue			Brown	412 0			
			Total vitamin A recovered = 49,64,774 I U				
Sample 2							
Undistilled oil			Reddish brown	512 0	5,000	25,60,000	25,60,000
Below 180°C.	1st	40	Yellowish dull brown	6 0	22,500	1,35,000	
	2nd	40	do	3 0	40,500	1,21,500	2,56,500
180° 200°C	1st	39	Brownish yellow	5 1	1,17,000	5,96,700	
	2nd	39	Yellow	3 7	1,17,000	4,32,900	
	3rd	39	do	3 0	1,23,750	3,71,250	14,00,850
200° 20°C.	1st	39	Pale yellow	17 0	22,500	3,82,500	
	2nd	38	do	8 3	20,625	1,71,187	5,53,687
220° 40°C	1st	37	Very faint yellow	48 6	5,550	2,69,730	2,69,730
Residue			Brown	408 0			
			Total vitamin A recovered = 24,80,767 I U				

TABLE III — DISTILLATION EFFICIENCY OF VITAMIN A FROM GROUNDNUT OIL

	POTENCY I U/gm	CONCENTRATION	RECOVERY I U
Original shark liver oil	28,000		
Cyclised fraction of above, 180° 200°C.	7,50,000	27 times	72/138 lakhs
Groundnut oil fractionated oil	9,000		
Cyclised fraction of above, 180°-200°C	3,25,000	36 times	28/48 lakhs

These results are explainable on the principle of extended distillation Vitamin A distilling at the temperature range 180°-200°C is associated with less of the glyceride fractions of groundnut oil than with the shark liver oil The method provides a wide field for working with alternate solvents and studying the distillation efficiency as regards vitamin A recovery

Summary

1 The odour of shark liver oil can be reduced by refluxing the oil dissolved in absolute alcohol or propylene glycol with skim-milk powder

2 A method of solvent fractionation of fish liver oil with groundnut oil has been worked out The solvent oil extracts vitamin A quantitatively and the solution thus obtained is nearly free from fishy odour. The product has been subjected to cyclic distillation to obtain vitamin A concentrates

Grateful acknowledgement is made to the Director of Fisheries, Government of Bombay, for generous supplies of shark liver oil samples

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Letters to the Editor

EXAMINATION OF INDIAN COALS BY X-RAY DIFFRACTION METHOD

ATTEMPTS HAVE BEEN MADE BY SEVERAL workers to examine coal for its mineral constituents by spectrographic methods A means of identifying the minerals unambiguously is afforded by the X-ray diffraction method, the superiority of which over other methods lies in that it can differentiate between minerals which have the same chemical formulae but different crystalline structure Nagelschmidt and Hicks[1] described a technique for the study of minerals in coal ash by the X-ray diffraction method As the compounds present in the ash are not identical with those present in the coal substance, an X-ray diffraction study of unmodified coal should be expected to give more precise information

The coal sample, C 34, was obtained from Jharia fields, Barakar series, seams VII and VIII combined The sample was powdered and made into a thick paste with collodion dissolved in ether A narrow cylindrical stick of diameter less than 0·5 mm was made, and this hardened rapidly as the ether evaporated The cylinder was mounted on the axis of a cylindrical camera X-rays from a Hadding tube run at about 60 kV and 8 to 10 ma were used From the measurements of the diameters of the diffraction rings in the photograph (FIG 1), the corresponding Bragg angle θ was obtained and the spacings of the reflecting planes d were calculated according to the Bragg formula,

$$2\,d\,\mathrm{Sin}\,\theta = \lambda,$$

where λ is the wavelength of the characteristic radiation ($\mathrm{Cu}k_{\alpha}$) In case of

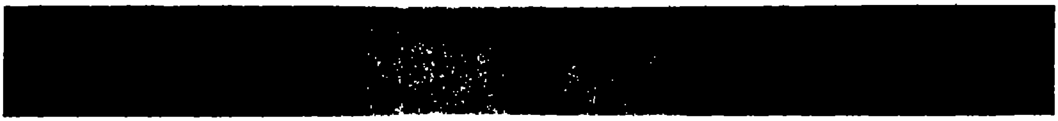

FIG 1

broad rings, the diameters of the edges were measured and the spacings corresponding to the extreme diameters were calculated This gives the range within which the actual spacing must lie

Different procedures have been followed for the identification of minerals by X-ray diffraction methods One method is by reference to charts of persisting lines published by Clarke *et al* [2] and the strong lines in the chart by Mehmel[3] Following this method, a chart of the strongest lines of different minerals present in coal according to earlier workers, particularly by Marson and Cobb[4], Gauger *et al* [5], and Ball[6] was prepared from published data, and the minerals identified with the help of the chart The spacing of the characteristic lines of different minerals whose presence is expected have been compared with those of the coal sample under examination The mineral, whose characteristic lines are found to agree both as regards spacing as well as intensity with some of the lines of the sample, is taken to be present The results shown in Table I and the results of the ash analysis of the same coal by Majumder[7] (TABLE II) show general agreement The broadening of some of the Debye-Scherrer rings was caused by the partial overlapping of lines due to more than one mineral The general lack of sharpness was due to the smallness of the particle size of some of the minerals There is, however, some ambiguity due to the presence of Kβ rays Further study of the same sample by using a nickel filter to cut off the Kβ rays and a bigger-sized camera to get better resolution, X-ray studies of the ash and the spectrographic examination, and X-ray study of more Indian coals, are in progress and will be reported elsewhere Investigations are also being carried out to determine the significance of the 5 48 AU band

My thanks are due to Prof K Banerjee for suggesting the problem and for his kind interest in the work and to Mr N N. Chatterjee for helpful discussion I am grateful to the Council of Scientific & Industrial Research for a research grant and

TABLE I — IDENTIFICATION OF MINERALS IN THE SAMPLE C_{34}

No	θ°	INTENSITY	d AU	CLARKE *et al.* & MEHMEL	CLARKE *et al*	MEHMEL			HANAWALT *et al.*		
				Kaolinite	Beidellite	Aragonite	Metahalloysite	Quartz	Pyrite	Dolomite	Anatase
1	6°12'	S	7 11	7 12							
2	8°4'	S band	5 48								
3	9°38 10°15	S	4 50 4 33	4 42	4 45		4 36				
4	11°48' 12°26	W	3 79 3 57				3 67				
5	12°44 13°12'	V.S	3 49 3 38	3 52		3 39		3 33			3 52
6	15°50'	W	2 82							2 89	
7	16°46' 17°32'	M	2 67 2 55	2 57	2 60		2 56		2 70		
8	18°19' 19°15	M	2 45 2 33	2 50 2 35		2 34	2 31		2 42		
9	20°29'	W	2 20							2 19	
10	22°3'	MW	2 06			1 98				2 02	
11	24°32'	MW	1 85			1 88		1 82	1 91		1 88
12	26°42'	MW	1 71	1 67	1 69	1 72					1 70
13	29°11'	MW	1 58						1 63		
14	30°7	MW	1 53		1 50		1 48	1 54			
15	33°12'	MW	1 41					1 37			

TABLE II — CHEMICAL COMPOSITION OF THE ASH OF SAMPLE C_{34} (MAJUMDER)

ASH %	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MgO	CaO	SO_3	P_2O_5	MnO	K_2O+Na_2O	TOTAL	Al_2O_3/SiO_2
25 97	67·18	24 99	1 80	2 76	0 17	0 80	0 41	0 73	×	0 58	99 42	0·37

for supplying the samples of coal, and to the authorities of I A C S for facilities to carry out the work.

G B MITRA

Indian Association for the
Cultivation of Science
Calcutta

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NUTRITIVE VALUE OF SOME SUBSIDIARY FOODS

CONSEQUENT ON THE SHORTAGE OF CEREALS, it has now become increasingly necessary to utilize tubers like tapioca and sweet potato which can be produced more abundantly than grain crops Groundnut cake also offers possibilities of utilization and is of special value because of its high protein content Recent investigations conducted under the auspices of the Subsidiary Food Production Committee have shown that specially processed groundnut cake flour can be used at a level of about 1 ounce *per capita* per day without any ill effect In view of the increasing importance of these food products, there is need for additional information regarding their nutritive value, both individually and in combination, in different processed forms

The chemical composition of tapioca flour, sweet potato flour and groundnut cake flour as also certain mixtures prepared out of them as compared with rice and wheat are given in Table I It will be seen that the main deficiency of tuber flours is in regard to the protein

Aykroyd and Krishnan[1] found that of the many foods tested as supplements to the poor tapioca diet, only casein and skimmed milk powder proved effective, while the different pulses, in spite of their high protein content, were comparatively ineffective Those authors, therefore, sounded a note of warning against the extended cultivation and use of tapioca as a staple food unless the diet could be supplemented by proteins of high biological value such as those of milk, fish, meat and eggs Since such foods are beyond the means of a large section of the population, there is a need to search for a cheap and effective protein supplement to tapioca and sweet potato Our investigations have shown that groundnut cake flour has a remarkable supplementary value to poor diets based on tapioca and sweet potato

In suggesting alternate food substitutes for cereals, we have to take into consideration not only their nutritive value but also their acceptability from the psychological point of view Food in the form of flour is not psychologically acceptable to rice eaters accustomed to eating food in the shape of grains The chief merits of the rice grain which makes it so popular as an article of food are (1) its attractive white or nearly white appearance, (2) its capacity for easy swelling and thus giving a sense of satisfaction to the consumer, and (3) its easy digestibility In view of these facts,

TABLE I — CHEMICAL COMPOSITION OF FOODSTUFFS USED IN THE EXPERIMENT

FOODSTUFF	MOISTURE %	PROTEIN %	FAT %	ASH %	CARBOHYDRATE %	CALORIFIC VALUE	CALCIUM %	PHOSPHOROUS %	VITAMIN B_1 %	NICOTINIC ACID %
Tapioca flour	9 0	1 7	0 5	1 4	85 5	353	0 06	0 08	0 12	1 8
Sweet potato flour	8 3	3 6	0 9	3 6	80 9	346	0 11	0 13	0 15	2 8
Groundnut cake flour	11 0	52 7	8 9	4 6	21 8	378	0 07	0 50	0 95	19 5
Raw milled rice	13 0	6 9	0 4	0 5	79 2	348	0 01	0 11	0 10	1 2
Mixture of tapioca flour (80 parts) and groundnut cake flour (20 parts)	9 4	11 9	2 2	2 0	73 8	359	0 06	0 16	0 30	5 3
Mixture of sweet potato flour (80 parts) and groundnut cake flour (20 parts)	8 8	13 4	2 5	3 9	69 2	353	0 10	0 20	0 31	6 1

TABLE II — AVERAGE WEEKLY INCREASE IN THE BODY WEIGHT OF YOUNG RATS FED ON DIFFERENT DIETS FOR 8 WEEKS

DIET No	QUANTITY OF RICE AND/OR RICE SUBSTITUTES IN THE DIET*	AVERAGE WEEKLY INCREASE IN THE BODY WEIGHT gm
1	Poor diet with raw milled rice (78 5%)	3 9
2	Poor diet with tapioca flour	−0 8 (all animals lost body wt and 3 died within 8 weeks)
3	Poor diet with sweet potato flour (78 5%)	−0 5 (all animals lost body wt and 3 died within 8 weeks)
4	Poor diet with tapioca flour (62 8%) and groundnut cake flour (15 7%)	10 3
5	Poor diet with sweet potato flour (62 8%) and groundnut cake flour (15 7%)	8 6
6	Poor diet with raw milled rice (58 9%), tapioca flour (15 7%) and groundnut cake flour (3 9%)	9 2
7	Poor diet with raw milled rice (58 9%), sweet potato flour (15 7%) and groundnut cake flour (3 9%)	9 4
8	Poor diet with synthetic cereal I (tapioca 70 parts, groundnut cake 20 parts and rice 10 parts) (78 5%)	7 6
9	Poor diet with synthetic cereal II (tapioca 70 parts, groundnut cake flour 20 parts and wheat 10 parts) (78 5%)	7 0

* All the diets contained the same quantity of other foods, viz red gram 5 0 per cent, non leafy vegetables (brinjal, potato and raw plantain), 8 2 per cent, leafy vegetables (amaranthus, cabbage, etc), 2 1 per cent, crude groundnut oil, 5 0 per cent, milk powder, 0 9 per cent, and common salt, 0 3 per cent

investigations were undertaken to explore the possibility of the preparation of grain substitutes from tapioca, with and without the addition of groundnut cake flour and also from millets We have found that maize or maize starch, on processing, yields a grain with cooking qualities similar to that of natural rice Flours from *cholam* and *ragi* also yield fairly satisfactory products, if their colour is not a disqualification Tuber flours and starches yield grains which tend to soften on cooking, with the result that the cooked product is pasty Such materials are more suitable, however, for preparing sago and sago-like products Supplements like groundnut cake flour or calcium salts have been added to the tuber flours or starches before processing to improve their nutritive value. Sago and sago-like products can also be used as partial rice substitutes.

The nutritive value of rice substitutes prepared from a mixture of tapioca flour (70 parts), groundnut cake flour (20 parts), rice or wheat (10 parts) as compared to rice has been studied by the rat-growth method The method adopted was the same as that described by Subrahmanyan and Sur[2] The results are summarized in Table II

The results confirm the earlier findings of Aykroyd and Krishnan (loc cit) that a poor diet based mainly on tapioca does not support life in young rats. The response to poor sweet potato diet is of the same order. The addition of groundnut cake flour to the tapioca or sweet potato diet produced, however, a remarkable improvement in the nutritive value of the diet, making it much superior to the rice diet The synthetic cereals prepared from a mixture of tapioca flour (70 parts), groundnut cake flour (20 parts) and rice or wheat (10 parts) possess a higher nutritive value than rice It will be noticed that the growth response (7 6 g and 7 0 g) of rats fed on diets containing the synthetic cereals I and II is somewhat lower than that obtained with a mixture of tapioca (80 parts) and groundnut cake (20 parts) This is probably due to losses of nutrients that might have occurred during the preparation of grains from the mixed flour It is interesting to note that even in the poor rice diet, replacement of 25 per cent of rice by a mixture of (1) tapioca (80 parts) and groundnut cake (20 parts) or (2) sweet potato (80 parts) and groundnut cake (20 parts) produces striking growth response

Full details will be shortly published elsewhere

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February 9, 1950

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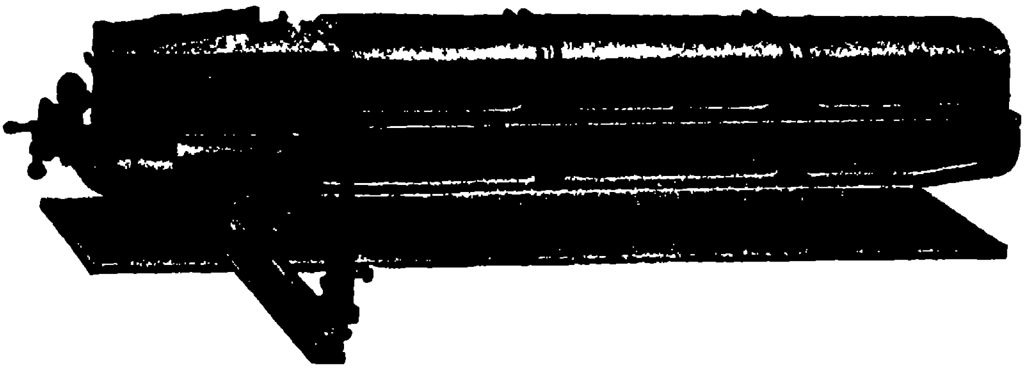

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Components of Indian Podophyllum

T R SESHADRI & S SANKARA SUBRAMANIAN

Departments of Chemistry & Chemical Technology, Andhra University, Waltair

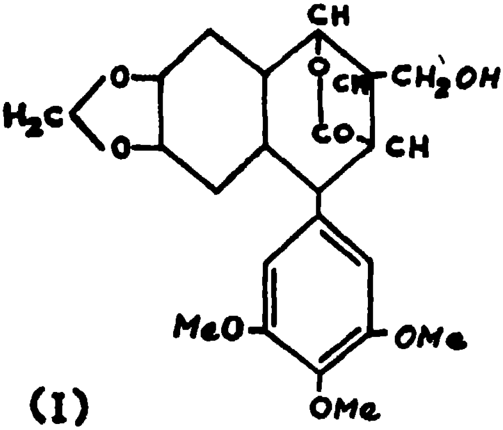
Podophyllotoxin and quercetin, the components of podophyllin obtained from *Podophyllum emodi* have been isolated in a pure state by fractional precipitation from an acetone solution A detailed study of podophylloresin, now designated "podophyllol", has been made

PODOPHYLLUM emodi Wall also called Indian Podophyllum is a small herbaceous plant found in the temperate parts of the Himalayas The rhizome of the plant has been used in Indian medicine as a purgative and a cholagogue for which purpose the allied American drug from *Podophyllum peltatum* is employed in Europe and America Both the Indian and American species are official in the *British Pharmacopoeia* A crude amorphous powder known as podophyllin containing a mixture of the active principles of the drug, has been adopted as the official preparation It is obtained by extracting the drug with hot alcohol concentrating the extract to small bulk and pouring it into a large volume of acidulated water The action of this mixture is considered to be due partly to a crystalline component podophyllotoxin and partly to a non-crystalline resin "podophylloresin"[1] The former has been reported to be more toxic than purgative and the latter more purgative than toxic[2]

The composition of podophyllin has been the subject of investigation by several workers Podophyllin from the American drug was first investigated by Podwyssotski[3] who reported the isolation of three substances, podophyllotoxin, podophyllic acid and, the crystalline yellow-colouring matter, podophyllo-quercetin He did not obtain the first two in a crystalline condition Later Kursten[4] succeeded in getting crystalline podophyllotoxin and in converting it into its isomer picropodophyllin by treatment with alkalies He concluded that podophyllo quercetin was not identical with quercetin from quercitron bark Dunstan and Henry[1] made a detailed study of podophyllin and compared the constituents of Indian and American podophyllum and reported that both contained the same podophyllotoxin quercetin and podophylloresin They found that *P emodi* yielded more podophyllin (10 12 per cent) than *P peltatum* (4-6 per cent) and also more podophyllotoxin

Of these components podophyllotoxin has been thoroughly studied and its constitution (I) more or less definitely established[5] Podophyllo quercetin obtained by Podwyssotski[3] as well as by Kursten[4] was shown by Dunstan and Henry[1] to be identical with quercetin from quercitron bark by preparing its penta acetate and tetramethyl ether They did not record the melting point of the free flavonol

Podophylloresin prepared by Dunstan and Henry[1] was a soft transparent, brownish-red resin yielding an acetate m p 198° From the analysis of its acetate they deduced the probable formula $C_{18}H_{16}O_{5}(OH)_{2}$ for the resin They also reported that by fusion of the resin with potash, protocatechuic acid (and probably *para* hydroxy benzoic acid) could be obtained In the light of the present work, the melting point of the acetate and the formation of protocatechuic acid would indicate considerable contamination of the podophylloresin with quercetin



(I)

Recently Hartwell *et al*[6] have reported the isolation of two new substances, α and β peltatins, by the fractionation of podophyllin from P *peltatum*, employing chromatographic adsorption on alumina. These compounds have been found to have high necrotizing activity for mouse sarcoma Details regarding their structural and biological studies have not yet been made available

Though the method of Dunstan and Henry involving fractional extraction for preparing the various components mentioned above has been useful, it is time-consuming and does not yield easily the components in a pure condition, this is mainly due to the separation being not efficient For example, even podophyllotoxin, which should be the easiest to purify, offered difficulty owing to the presence of viscous resinous substances, also extracted by hot chloroform Hence a better method of isolation was needed In view of the fact that P *emodi* compares favourably with quercitron bark in dyeing property (Hummel[7]), the possibility of isolating quercetin readily for laboratory use by a simple method from the commercially available Indian podophyllin required consideration Since no detailed study has been made of podophylloresin, the therapeutically more important component, its purification and study was considered important

The method now adopted for separating the components involves fractional precipitation from an acetone solution of podophyllin, using chloroform and ether Podophyllotoxin and quercetin are obtained easily in pure state and in good yields (about 35 and 7 per cent respectively). The former has been characterized by its melting point, optical rotation, colour reactions and by converting it into picropodophyllin A convenient method of oxidation is to use alkaline hydrogen peroxide whereby oxalic and trimethyl gallic acids are readily obtained Quercetin could be easily isolated in the form of bright-yellow needles melting at 315°-16° (decomp) and characterized by preparing its penta-acetate, tetramethyl ether and pentamethyl ether and comparing with authentic samples.

The fraction corresponding to podophylloresin has been obtained in a much purer condition than before in a yield of 8 per cent This is insoluble in chloroform and ether, but dissolves in cold aqueous sodium hydroxide, carbonate and bicarbonate By using its solubility in bicarbonate it could be rendered considerably pure Still it was not possible to crystallize it from hot solvents because of its instability Hence it has been further purified by solution in alcohol and precipitation with ether, and finally obtained as a pale-brown coloured microcrystalline powder decomposing at about 115° It forms easily a crystalline acetate, m p 265°, and a methyl ether, m p. 168°, which could be obtained in an almost crystalline condition It exhibits close resemblance to podophyllotoxin in being optically active (the pure acetate was used for estimating the optical rotation) and in giving similar characteristic colour reactions including the methylene-dioxy group test Further, on oxidation with hydrogen peroxide and on treatment with conc nitric acid in glacial acetic acid medium, it readily yields oxalic acid like podophyllotoxin, but no other bigger unit could be isolated so far In contrast with podophyllotoxin, it gave a greenish-brown colour with ferric chloride indicating the presence of a free phenolic hydroxyl group It is now designated "podophyllol" as the older name "podophylloresin" does not clearly distinguish it from the resinous mixture of podophyllum (podophyllin)

In view of these properties, podophyllol may be considered to consist essentially of a compound which, like podophyllotoxin, is a member of the lignan group. It has also methylene-dioxy and methoxyl groups present in it From the nature of its methyl ether it would appear that there is only one free phenolic hydroxyl group in podophyllol The molecular size of the acetate indicates close approximation to podophyllotoxin

No picropodophyllin has been met with during the above-mentioned separation of the components and purification This shows that it does not occur as such in the plant, a view earlier expressed by Dunstan and Henry Further, the sample of podophyllol should be quite free from podophyllotoxin, as otherwise, during the course of the purification with alkali, at least a small quantity of picropodophyllin would have been formed and detected because of its sparing solubility Similarly, during the course of purification of podophyllol by this method, no similar isomeric change seems to be taking place, for the substance obtained by simple solution in alcohol and fractional precipitation with water as well as the one obtained through alkali treatment gave the same acetate and methyl ether

Toxicity tests using fish as test animals reveal that podophyllotoxin is toxic while its isomer, picropodophyllin, is non-toxic. Podophyllol has been found to be less toxic than podophyllotoxin, but its purified methylation product is markedly more toxic The influence, therefore, of the free phenolic group in podophyllol is to reduce toxicity and this agrees with the earlier findings with regard to the toxic properties of these compounds[7]

In considering the physiological action of podophyllin, besides the components podophyllotoxin and podophyllol, the possible influence of quercetin present in high proportions should not be neglected It has been reported that flavonols like rhamnetin and kaempherol have diuretic and cathartic action[8,9] Recently it has been shown that quercetin has marked activity in relation to potentiation of epinephrine effects associated with vitamin P (Clark and Geissman[10]) It may be mentioned here that many flavones in plant drugs have marked physiological action (Seshadri[11])

Experimental

Separation of the Components—Podophyllin (20 gm.) from *P. emodi* was taken up in acetone (50 c c.) and the solution filtered from the small amount of undissolved matter consisting mainly of inorganic salts of calcium and magnesium. It was then treated with excess of chloroform (400 c.c) and shaken, when a sticky resin (A) slowly separated out and adhered to the sides of the container The clear solution was decanted off and diluted with an equal volume of chloroform whereupon quercetin (0 8 gm) separated out as a fine yellow powder and was filtered It was almost pure and melted at 295°-300° When crystallized twice from alcohol-chloroform mixture, it was obtained as yellow needles melting at 315°-16° (decomp)

The chloroform filtrate was distilled to recover the solvent The solid residue was triturated with sodium carbonate solution (5 per cent) rapidly in the cold, using 50 c c each time in order to remove all traces of quercetin and resin 3 to 4 such extractions left a fine powdery mass which was washed well with water and finally with a little very dilute hydrochloric acid to remove the last traces of alkali. Two crystallizations from hot alcohol gave fine colourless prisms of podophyllotoxin melting at 115°-17°, yield 7·0 gm

The sticky resin (A) in the container was again taken up in acetone (25 c c), and ether (250 c c) added to it, when a brown amorphous powder (B) separated out The clear ether solution was concentrated and the residue crystallized from alcohol-chloroform mixture when a further quantity of quercetin (0 6 gm.) was obtained

Attempts were made to separate the amorphous powder (B) into fractions by employing difference in solubility in sodium bicarbonate, carbonate and hydroxide solutions Most of it could be dissolved by repeated treatment with bicarbonate solution As a convenient alternative, the resin was dissolved in cold sodium hydroxide (5 per cent) solution and the solution saturated with carbon dioxide A small highly coloured portion separated out, but most of the substance was in solution The mixture was filtered to remove the precipitate and the filtrate was cooled in ice and acidified with conc hydrochloric acid The bulky precipitate was filtered, washed with water and dried For further purification it was dissolved in alcohol and to the solution ether was added when a pale-coloured solid decomposing at about 115° was obtained. This was "podophyllol".

Identification of Podophyllotoxin — M p. 115°-17° (decomp.), specific rotation, $[\alpha]_D^{28^\circ} = -102{\cdot}1^\circ$ in ethyl alcohol When the substance (1·0 gm) was boiled with aqueous alkali (25 c c, N NaOH) until completely dissolved and the solution acidified with dilute hydrochloric acid, a white precipitate was obtained; this was washed with water and crystallized from hot alcohol when long silky needles melting at 225°-27° and having no optical activity were obtained (picropodophyllin, m p 227°) Both substances gave characteristic colour reactions with conc sulphuric acid (pink red) and nitric acid (deep red changing to yellow) and answered the methylene-dioxy test with gallic acid and conc sulphuric acid (bluish-green colour)

Podophyllotoxin sample (1·0 gm) was dissolved in aqueous potassium hydroxide (5 per cent, 20 c c) and hydrogen peroxide (30 per cent, 10 c c) added dropwise in the course of half an hour, keeping the temperature at 60°C The solution was then boiled to decompose excess hydrogen peroxide, cooled and acidified with dilute hydrochloric acid The mixture was repeatedly extracted with ether Picropodophyllin (0·4 gm) was left behind as a solid insoluble in ether The ether solution was separated and extracted with aqueous sodium bicarbonate (5 per cent) This extract was acidified and once again extracted with ether This ether solution was evaporated, the residue dissolved in dilute ammonium hydroxide and the solution treated with a hot solution of calcium chloride, when a crystalline precipitate (p) separated out The filtrate, when acidified and concentrated, yielded an acid, m p 165°-67° The mixed melting point with an authentic sample of trimethyl gallic acid was not depressed The crystalline precipitate (p), on decomposition with mineral acid, yielded oxalic acid

Identification of Quercetin — The pure flavonol sample had a melting point of 315°-16° (decomp) It gave a deep-yellow solution with sodium hydroxide and in alcoholic solution an olive-green colour with ferric chloride. With conc sulphuric acid a deep-yellow colour was produced

The penta-acetate crystallized from ethyl acetate-petroleum ether mixture as colourless needles melting at 196°-97° and the mixed melting point with an authentic sample of quercetin penta-acetate was not depressed.

Methylation of the flavonol with 4 moles of dimethyl sulphate and excess of anhydrous potassium carbonate in dry acetone solution yielded the tetramethyl ether which crystallized from alcohol as long, pale-yellow needles, m p 154°-55°. When excess of dimethyl sulphate was employed, the pentamethyl ether was obtained as colourless needles, m p 150°-51°, and this was not affected by admixture with an authentic sample of pentamethyl quercetin

Podophyllol — The compound was easily soluble in alcohol, soluble in acetone and insoluble in ether and chloroform In alcoholic solution it gave a greenish-brown colour with ferric chloride and dissolved in sodium hydroxide giving a reddish-brown colour. It gave a purple colour with conc. sulphuric acid, a cherry red turning to yellow with conc nitric acid and a bluish-green colour with conc sulphuric and gallic acids indicating the presence of a methylene-dioxy group It was strongly reducing to alkaline permanganate It melted at 115° (decomp) sintering earlier at 110° (Found. C, 58·4, H, 5 4, $C_{22}H_{22}O_8$, H_2O requires: C, 58 8, H, 5 9 per cent)

Acetate — Podophyllol (2·0 gm) was boiled with acetic anhydride (15 c c) and fused sodium acetate (5 gm) for 2 hr The reaction mixture was poured into ice-cold water when a pale-brown solid was obtained It was easily soluble in chloroform and only sparingly soluble in alcohol. When crystallized from alcohol-chloroform mixture, it came out as stout silky needles melting at 263°-65° (decomp) (Found C, 60·7; H, 5·2, OCH_3, 7·7 per cent, mol. wt. (Rast), 488, $C_{22}H_{24}O_9$ requires · C, 61·1; H, 5·6; OCH_3, 7·4 per cent, mol wt, 432.) It was optically active, $[\alpha]_D^{28^\circ} = -55{\cdot}0^\circ$ in chloroform It gave colour reactions similar to podophyllotoxin including the methylene-dioxy group test It did not give any colour with alcoholic ferric chloride.

Methyl Ether — Podophyllol (2·5 gm) was methylated by refluxing with dimethyl sulphate (3·0 c c) and anhydrous potassium carbonate (10 gm.) in dry acetone medium for 30 hr. The acetone solution was filtered and the solvent distilled. Water was added to the residue and the solid that separated was filtered and dried. It was dissolved in chloroform and to the solution petroleum ether was added, when it slowly separated as a fine powder. This operation was repeated when it was obtained as a colourless micro-crystalline solid melting at 165°-68° (decomp.) (Found C, 57·3; H, 5·8; OCH_3, 15·0; $C_{21}H_{24}O_8$, $2H_2O$ requires:

C, 57·3 ; H, 6·4, OCH_3, 14·5 per cent) It also gave colour reactions like the acetate, was insoluble in sodium hydroxide and did not give any colour with alcoholic ferric chloride

Oxidation with Alkaline Hydrogen Peroxide — Podophyllol was oxidized by means of alkaline hydrogen peroxide as described under podophyllotoxin Only oxalic acid could be identified as a product of oxidation.

Action of Conc Nitric Acid — Podophyllol (0·5 gm) was dissolved in glacial acetic acid (10 c c) and an equal volume of conc nitric acid added The solution was kept in a boiling water bath for 1 hr and the mixture poured into water (100 c c). No solid separated, but on concentrating the solution on a water bath, oxalic acid was obtained, yield, 0·15 gm

Toxicity Tests — Using fresh-water fish (*Haplochilus panchax*) as test animals and following the method described earlier[12], podophyllotoxin was found to be toxic in a concentration of 100 mg per litre in 3 hr 7 min, while picropodophyllin in the same concentration was non-toxic even after 10 hr Podophyllol exhibited toxicity in 4 hr 16 min while its purified methylation product was toxic in 50 min, both in a concentration of 100 mg per litre (Gelatin, 1·0 gm per litre, was employed in these experiments in order to get clear solutions)

Summary

Podophyllin from Indian podophyllum has long been used in medicine and has earlier been reported to contain podophyllotoxin, quercetin and podophylloresin An easy method of separation of the components involving fractional precipitation from an acetone solution is described. Podophyllotoxin and quercetin have been isolated pure and characterized, the fraction corresponding to podophylloresin has been obtained as a pale-brown micro-crystalline powder decomposing at 115° In view of its phenolic properties, it is given the name " podophyllol " Its acetyl and methyl ether derivatives exhibit optical activity On oxidation with nitric acid and alkaline hydrogen peroxide, podophyllol yields oxalic acid in large amounts. Podophyllol also contains a methylene-dioxy group It is considered to be essentially a member of the lignan group and is closely related to podophyllotoxin.

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Chemical Examination of *Archa* (*Sonnertia acida* Linn.) — Part II : Studies in the Constitution of Archin & Archinin

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The colouring matters archin and archinin, from *Sonnertia acida* Linn , have been shown to be identical with 1 : 3 . 8-trihydroxy-6-methyl anthraquinone and 1 : 8-dihydroxy-3-methyl anthraquinone respectively.

IN a previous communication Chaudhry and Siddiqui[1] reported the isolation of two colouring matters and a colourless crystalline product from the wood of *Sonnertia acida* Linn , which they provisionally named as archin, $C_{15}H_7O_2(OH)_3$, archinin, $C_{15}H_8O_2(OH)_2$, and archicine, $C_{17}H_{14}O_{12}$, respectively The present paper deals with the results of further studies in the constitution of archin and archinin

From the molecular formulae of archin and archinin and their respective hydroxyl contents it was apparent that archin differs from archinin in having an additional hydroxyl group Although archin dissolves in sodium bicarbonate and thus is strongly acidic in character, both archin and archinin sublimed unchanged in an atmosphere of carbon dioxide, which indicated the absence of carboxyl group in either of them On treatment with zinc dust and hydrochloric acid, archin and archinin gave reduction products which were lighter in colour, conformed to the formula $C_{15}H_{12}O_4$ and $C_{15}H_{12}O_3$ respectively, and were susceptible to atmospheric oxidation, particularly in alkaline medium, yielding back the original colouring matters As both archin and archinin further failed to give their corresponding phenyl-hydrazones, these results showed that the remaining two oxygen atoms in archin and archinin were present in a quinonic grouping.

On distillation with zinc dust at red heat in hydrogen atmosphere, both archin and archinin gave an identical hydrocarbon conforming to the molecular formula $C_{15}H_{12}$. This hydrocarbon, on oxidation with excess of chromic acid in acetic acid medium, yielded an acid (m p 285°C) which analysed for the formula $C_{15}H_8O_4$ This acid, on distillation with zinc dust in hydrogen atmosphere, gave a hydrocarbon corresponding to the formula $C_{14}H_{10}$, which was identified as anthracene through a comparison of the melting point and mixed melting point with an authentic sample.

These findings led to the conclusion that the hydrocarbon $C_{15}H_{12}$, obtained through distillation of archin and archinin with zinc dust, was a methyl-anthracene and that archin and archinin were trihydroxy and dihydroxy-methyl-anthraquinones respectively. Amongst the known methyl-anthracenes, the physical and chemical properties of β-methyl-anthracene appeared to correspond to the $C_{15}H_{12}$ hydrocarbon mentioned above, while out of the hydroxy derivatives of β-methyl-anthraquinones the physical and chemical characteristics of 1·3 8-trihydroxy-6-methyl-anthraquinone (Frangula emodin) and 1 8-dihydroxy-3-methyl-anthraquinone (Chrysophanic acid) and their derivatives appeared to correspond to those of archin and archinin and their corresponding derivatives respectively The identity of archin and archinin with frangula emodin and chrysophanic acid respectively was finally established through a comparison of their melting points and mixed melting points and those of their corresponding derivatives.

Although a hydroxy-napthaquinone has been reported to occur in *Lawsonia alba*[2], which belongs to the Lythraceae family, the occurrence of anthraquinone derivatives in this family was not reported so far. It is further interesting to note that although the drug contains emodin which is used as a purgative, and chrysophanic acid which finds extensive use in skin diseases, there is no reference in indigenous systems of medicine to these uses of *archa*. The possibility of utilizing this source for the industrial production of these costly medicinals is being investigated, and the results will be dealt with in a separate communication

Experimental

Reduction of Archin & Archinin — Archin and archinin on reduction with zinc dust and hydrochloric acid in glacial acetic acid medium yielded the corresponding quinols melting at 235°C and 200°C respectively The reduction product from archin on analysis gave C, 70·2 , H, 4 8 , $C_{15}H_{12}O_4$ (emodin-anthranol) requires C, 70 3 , H, 4 7 per cent The reduction product from archinin gave C, 74 6 , H, 5 3 , $C_{15}H_{12}O_3$ (chrysophan-anthranol) requires C, 75 0 , H, 5·0 per cent

Zinc Dust Distillation of Archin & Archinin — Archin, intimately mixed with zinc dust, was heated to dull-red heat in hydrogen atmosphere in a combustion tube filled with zinc-coated pumice After the heating was over, the contents of the receiver as well as the tube were extracted with ether The fluorescent ethereal solution was shaken out with dilute caustic soda, washed with water, dried over anhydrous sodium sulphate and freed of the solvent The residue after crystallization from petrol ether yielded light-yellow silky needles (m p 198°C), found. C, 93·4 , H, 6 2 , M W (Rast), 175 , $C_{15}H_{12}$ requires C, 93·8 , H, 6 2 per cent , M W , 192 Archinin, on zinc dust distillation in a similar manner, yielded an identical hydrocarbon as established through its melting point, analysis and mixed melting point with the hydrocarbon obtained above Neither of these samples gave any depression in melting point on admixture with an authentic sample of β-methyl-anthracene

The hydrocarbon on oxidation with chromic acid in glacial acetic acid medium in the hot gave an acid (m p 285°C) which on analysis after drying gave C, 71 2 , H, 3 4 , $C_{15}H_8O_4$ requires C, 71 4 , H, 3 2 per cent The acid did not give any depression in melting on admixture with an authentic sample of anthraquinone-2-carboxylic acid

The acid on distillation with zinc dust gave a hydrocarbon which was identified as anthracene through its melting point, analysis and mixed melting point with an authentic sample of anthracene

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Microbiological Determination of Cystine in Foods & Proteins

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A microbiological method for cystine estimation in proteins and foods employing *L arabinosus* 17-5 (A.T.C.C 8014) as the test organism has been described. The experimental conditions for the hydrolysis of proteins and for estimating the amino acid have been defined.

MICROBIOLOGICAL assay methods have been developed for all amino acids[1-19] excepting hydroxy proline The estimation of cystine in proteins, however, presents a few difficulties A large number of micro-organisms have been suggested and employed[7,20] for its estimation, and the preliminary acid hydrolysis of proteins, under the conditions normally employed, leads to the destruction of the amino acid A reproducible procedure which can be applied for cystine estimation in foods and proteins is, therefore, called for

The method employed is based on the observation that *L arabinosus* and a few other organisms require *l*-cystine for growth as an essential nutrient Using a cystine-free but otherwise complete basal medium, the growth response of the organism to the addition of graded dosages of cystine is determined, the acid produced in a given time being taken as a measure of the amount of the added cystine in the medium A standard reference curve showing the relation between acid produced and concentration of cystine is prepared

Experimental

Choice of Micro-organism — A study of the relative merits of different micro-organisms — *Lactobacillus arabinosus*, 17-5 (A T C C 8014), *Leuconostoc mesenteroids* (A T C C 8042), *Streptococcus faecalis* (N C T L 6459) and *Lactobacillus fermentus* (A T C C 9338) — for the estimation of cystine was made using the same basal medium (10 c c), the growth period being 48 hr The concentration of *l*-cystine in the medium varied from 0 to 100γ The acid production was measured by titration with 0 1 *N* NaOH The results are given in Table I and graphically represented in Fig 1

Leuconostoc mesenteroids gives a uniform curve though the maximum growth is reached with 40γ *l*-cystine *Lactobacillus fermentus* gives an irregular curve and *Streptococcus faecalis* is a poor acid producer With *Lactobacillus arabinosus*, however, a steep and uniform curve is obtained over the entire range, though the blank value is somewhat high

The reasons for the high blank value with *L arabinosus* are not known The value is not due to methionine (Fig 2), nor is it due to any cystine impurity in the amino acids (Fig 3) present in the basal medium

Lactobacillus arabinosus and *Streptococcus faecalis* give practically the same trend of results with varying quantities of cystine *Lactobacillus arabinosus*, however, is to be preferred as the acid production is higher. Further, *L arabinosus* does not require folic acid as an essential nutrient and for this reason it offers practical advantage over *S faecalis*

Factors Governing the Hydrolysis of Proteins

Hydrolysis of Proteins — The conditions employed for the acid hydrolysis of proteins affect the cysteine and cystine concentrations in the hydrolysate Our studies have shown that autoclaving at 120°C. for 5 hr

TABLE I

CONCN OF CYSTINE, γ	C.C. 0 1 *N* NaOH REQUIRED			
	Lactobacillus arabinosus	*Leuconostoc mesenteroids*	*Streptococcus faecalis*	*Lactobacillus fermentus*
0 00	3 9	3 4	1·4	2 6
5 0	6 0	4 5	2 0	2 9
10 0	7 0	5 4	2 3	3 9
20 0	8 3	6 4	2 8	4 1
30 0	9 2	6 8	3 1	4 0
40 0	10 2	6 9	3 4	3 8
50 0	10 4	6 9	3 6	3 7
70 0	10 9	7 0	3 9	3 7
100 0	10 8	7 0	4 4	3 8

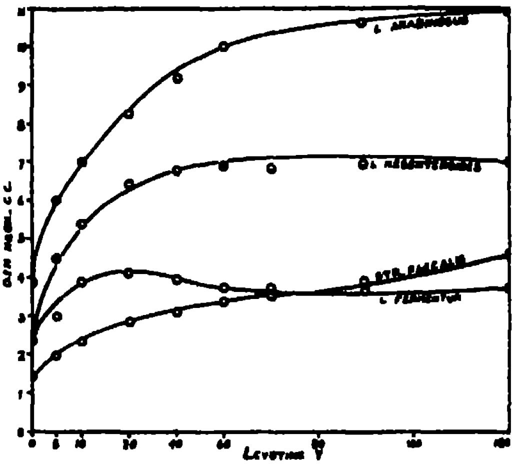

Fig 1 — Standard curve for cystine estimation (method official)

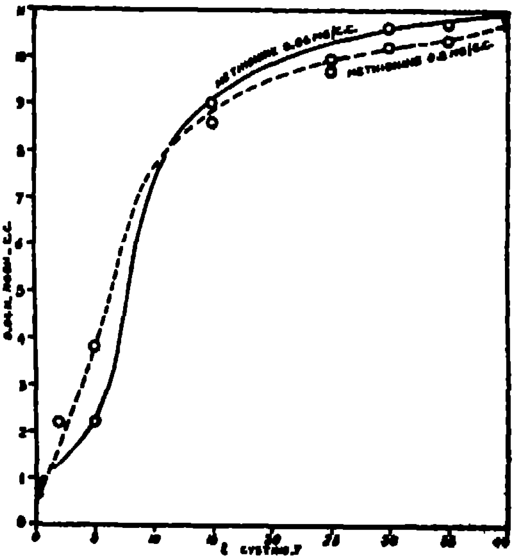

Fig 2 — Standard curve for the estimation of cystine with *L. arabinosus*

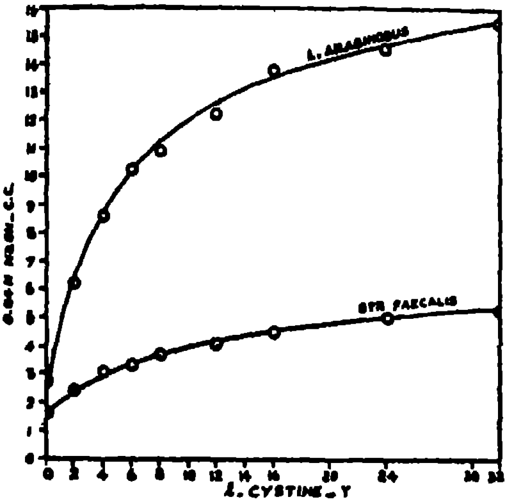

FIG 3 — STANDARD CURVE FOR THE ESTIMATION OF CYSTINE WITH *L arabinosus* AND *Str faecalis*

TABLE II

CYSTINE IN WOOL, mg.	ADDED *l*-CYSTINE, mg	CYSTINE IN HYDROLYSATE, mg.	CYSTINE RECOVERED, %
30	50	80	100
30	50	76	95
30	50	80	100

in the case of foodstuffs and 7 hr in the case of proteins like keratin, using 1 gm of the material and 20 c c of 3 *N* hydrochloric acid in a sealed pyrex tube, effects a total release of cystine without any material loss of the amino acid

To establish the validity of the procedure, known quantities of *l*-cystine were added to a sample of wool before hydrolysis and the total cystine estimated in the hydrolysate The results given in Table II show that the recovery of the added cystine is quantitative.

Reagents Required

Amino Acid Mixture I — 500 mg each of glycine, *dl*-isoleucine, *l*-leucine, *dl*-threonine, *l*-tyrosine and *dl*-valine, and 4 c c of 20 per cent HCl in 250 c c of double-distilled water

Amino Acid Mixture II — 250 mg each of *dl*-norleucine, *l*-proline, *dl*-serine and *dl*-phenylalanine, 125 mg each of *l*-histidine and *l*-hydroxyproline, and 10 c c of 20 per cent HCl in 250 c c. double-distilled water.

Amino Acid Mixture III — 1·25 gm. each of *dl*-alanine, *l*-glutamic acid and *l*-aspartic acid, 500 mg. each of *l*-arginine and *dl*-asparagine, and 5 c c of 20 per cent HCl in 250 c.c of double-distilled water

Purine Solution — 0 25 gm each of adenine sulphate, guanine hydrochloride and uracil, and 8 c c of 20 per cent HCl dissolved in 200 c c double-distilled water, sterilized in an autoclave at 120°C for 20 min

Salt Solution A — 5 gm of $MgSO_4\,7H_2O$, and 0·2 gm each of NaCl, $FeSO_4\,7H_2O$ and $MnSO_4\,4H_2O$ together with 0·15 c c of 20 per cent HCl in 100 c c

Biotin Solution — 40 γ biotin in 100 c c of 50 per cent alcohol

Niacin Solution — 10 mg of niacin in 100 c c of 50 per cent alcohol, stored in a coloured bottle

Vitamin Solution I — 20 mg of riboflavin and 10 mg of thiamine hydrochloride in 1 litre of 0·02 *N* acetic acid, stored in a coloured bottle

Vitamin Solution II — 10 mg each of *d*-calcium pantothenate, *p*-aminobenzoic acid and pyridoxine hydrochloride in 100 c c of 50 per cent alcohol, stored in a coloured bottle 10 c c of the solution are diluted to 100 c c before use

Cystine Solution — 10 mg of cystine in 100 c c of water

Agar Media for Stock Culture — 1·5 gm of agar, 1 gm yeast extract, 1 gm "tryptone", and 0·5 gm dextrose in 100 c c. of water

Basal Medium — The medium consists of the following dextrose 4 4 gm , sodium acetate, 3·0 gm , ammonium sulphate, 1 4 gm , *dl*-tryptophane, 11 mg , *dl*-methionine, 22 mg , *l*-lysine, 22 mg , amino acid mixture I, 22 c c , amino acid mixture II, 22 c c , amino acid mixture III, 22 c c , salt solution A, 2·2 c c , salt solution B, 2 2 c c , purine solution, 2 2 c c , vitamin solution I, 2 2 c c , vitamin solution II, 2 2 c c , nicotinic acid, 0·22 c c , and biotin, 0 4 c c in 220 c c After adjusting the *p*H to 6·8, 4 c c of the medium are distributed into each culture tube

Procedure

1 gm of wool (washed and dried) or other material, cut into small pieces and charged into 50 c c. pyrex tubes, 20 c.c of 10 per cent of 3*N* HCl added, and the tube sealed off, hydrolysis effected in an

autoclave at 120°C for 7 hr The tube is broken and contents and washings made up to 80 c c

2 c c of 2 5 M sodium acetate (buffer) are added to the hydrolysate and the *p*H adjusted to 6 8 first with 10 *N* NaOH (5 c c) and finally with *N* NaOH (4-5 c c) testing externally with bromothymol blue The contents are diluted with distilled water to 100 c c

To 10 c c of the basal medium 2 c c of standard cystine solution were added and the medium sterilized at 115°C for 15 min

A micro-drop of a diluted 24-hr culture of *L arabinosus* was inoculated with the medium and the tubes incubated in the dark at 35°-36°C for 48 hr

After the incubation period the tubes were cooled in the refrigerator for 15 min to stop growth The contents of each tube were transferred to a 50 c c beaker rinsing the tube thrice with about 4 c c of distilled water Two drops of 0 1 per cent bromothymol blue were added and titrated against 0 04 *N* NaOH to a greenish-blue colour It is important to keep the first beaker as a reference end point so that all tubes are titrated to the same tint and *p*H

From the titration values of the standard cystine tubes a standard curve is prepared Values for a typical standard are shown in Table III and Fig 4

The cystine contents corresponding to the titration values of test media are determined with reference to the standard curve (Fig 4) The average concentration of cystine per sample is determined from 3 or 4 different tubes containing different concentration of the test solution The values of a typical estimation are given in Table IV

The cystine contents of a large number of substances have been determined by the procedure outlined here The results obtained are compared with the values reported in the literature (Table V)

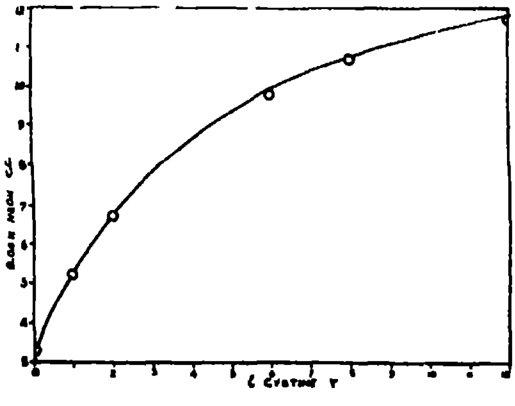

Fig 4 — Standard curve for the estimation of cystine with *L arabinosus*

TABLE III

Total vol 4 c c 1 c c of cystine solution contain 20γ of cystine

Cystine soln c c	Water c c	Medium c c	Titre, c.c. of 0 04 *N* NaOH
0 0	1 0	3	3 20
0 05	0 95	3	5 20
0 10	0 90	3	6 70
0 15	0 85	3	7 90
0 20	0 80	3	8 70
0 30	0 70	3	9 60
0 40	0 60	3	10 70
0 60	0 40	3	11 4
0 80	0 20	3	12 70
0 90	0 10	3	13 20

TABLE IV

Total vol 4 c c incubation period 48 hr

Sample	Hydrolysate c c	Titre, 0 04*N* c c	Cystine in the tube, γ	Cystine per gm of sample mg	Average value
Rat hair (normal)	0 05	7 00	3 00	120	122
	0 10	8 2'	6 00	120	
	0 20	9 90	12 50	125	
Rat hair I (abnormal)	0 05	5 60	1 25	50	52
	0 10	7 30	2 55	51	
	0 20	9 60	5 50	55	
Rat hair II (abnormal)	0 05	5 70	1 30	52	52
	0 10	7 50	2 55	51	
	0 20	9 50	5 30	53	
Wool (normal)	0 05	7 50	4 40	88	90
	0 10	9 10	9 20	92	
	0 20	11 00	18 0	90	
Wool (kempy)	0 05	5 60	0 70	28	30
	0 10	7 30	1 50	30	
	0 20	8 70	2 80	28	
	0 30	10 10	5 25	35	

TABLE V

Material	Cystine found %	Cystine reported %
Wool[21]	10 2	11 1±0 9
Rat hair[21]	12 9	13 4
Whole wheat[21]	1 1	1 3±0 3
Wheat flour[21]	1 4	1 6–1 9
Palm oil cake[22]	1 7	1 7

Acknowledgements

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Cytological Studies of A-Vitaminosis in Toddy Yeast

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Actively growing toddy yeast cells rapidly build up chromatin when grown on an all vitamin media and only a gradual formation is observed when grown on a niacinless media There is no formation of fresh chromatin when the yeast is grown on a basal medium consisting of glucose and salt solution

A SYSTEMATIC study of the vitamin requirements of this toddy yeast[1] showed that niacin was indispensable for its growth A microscopic examination of the yeast cells grown with and without niacin revealed that niacin has an important part to play in the nuclear apparatus The cytochemical study of this a vitaminosis has already been published[2]

The previous results observed in actively growing cultures led us to find out if we could more definitely assign the rôle of niacin in cell growth and differentiation

Experimental

The toddy yeast was grown in three different media (1) basal media (2) all vitamin media and (3) niacinless media (Table I) The yeast was grown for 24 hr at 28°C and then smears from each were fixed for half an hour in Cornoy and stained in toluidine blue

In another set of experiments the tubes with 24-hr yeast growth were centrifuged the supernatant poured off and fresh media 5 c c of each type was added to each tube Under these conditions it was expected that due to addition of new media growth and division would be initiated in cases where there was utilization of the substrate (glucose) and where the organism had its normal supply of the essential factor (niacin) In the other two cases namely (i) basal media and (ii) media lacking in niacin there would be an indication of how the lack of a specific factor affected the cytological picture To observe this sequence of events in the cell life permanent preparations were made at intervals of 1 hr in each of the three types of media during a period of 6 hr

The cells after the addition of the new material would enter the growth phase and the cytological picture would not be marred by the reserve cell materials because Cornoy would remove most of the cytoplasmic

TABLE I — COMPOSITION OF THE DIFFERENT MEDIA

	BASAL	ALL-VITAMIN	WITHOUT NIACIN
Glucose, gm.	5 0	5 0	5 0
Salt solution, c.c.	12 5	12 5	12 5
Potassium citrate buffer, c.c.	5 0	5 0	5 0
Ammonium sulphate, gm.	0 4	0 4	0 4
l asparatic acid, mg.		10 0	10 0
l tryptophane, mg.		1 2	1 2
l-cystine, mg.		4 0	4 0
l methionine, mg.		4 0	4 0
Thiamin, μg.		80	80
Riboflavin, μg.		80	80
Pyridoxin, μg.		80	80
Pantothen, μg.		80	80
Niacin, μg.		80	
Para amino-benzoic acid, μg		10	10
Biotin, mμg		200	200
Inositol, μg		200	200
Choline chloride, μg		400	400

*p*H 4 6, volume 100 c.c. in each of the three types.

TABLE II — TOTAL NUMBER OF STAINED CELLS & CELLS AT DIVISION

TIME, hr	BASAL MEDIUM		ALL VITAMIN MEDIA		NIACINLESS MEDIA	
	Cells stained %	Cells in division %	Cells stained %	Cells in division %	Cells stained %	Cells in division %
0	51	25	60	25	40	16
1	42	25	80	55	56	24
2	27	18	60	38	74	40
3	40	19	54	29	78	45
4	30	19	30	19	70	40
5	22	8	15	7	68	24
6	7	7	16	7	68	33

storage products The permanent preparations thus made were observed to find out (1) the total number of stainable cells with definitely stained bodies and (2) the number and percentage of cells in active state of division at the end of each hour in different media (TABLE II)

Observations

(a) *Basal Media* — At the end of 24-hr growth, the small percentage of cells in division stages pass steadily into the resting stage and addition of fresh media has no further accelerating action either on the growth or on the division of yeast cells The percentage of stainable cells steadily decreases

(b) *All-vitamin Media* — The picture at the end of 24-hr growth is almost the same as that of basal media, but the addition of the new media (all-vitamin) initiates division and the highest percentage of stainable cells as well as the percentage of cells in division reach a climax at the end of the first hour and then steadily decrease

(c) *Niacinless Media* — To begin with, at the end of 24 hr. the division figures are slightly lower than in the first two cases. Addition of fresh media (niacinless) induces gradually an increase in the division figures and they reach their highest value only at the end of 3-hr The cycle of division does not complete itself in the next 3 hr as in the previous case

Discussion

The staining with toluidine blue after Cornoy fixation can be taken to indicate that those parts which retain the dye reflect, in a large measure, the chromatin content of the cells Taken in this light, the total percentage of the stained cells in the three different media indicate the building up of chromatin in the cells under study

The results indicate that in the basal media there is no fresh accumulation or formation of chromatin-like substance after the addition of new media

In the case of all-vitamin media, there is a sharp climb towards building up of chromatin in the cells The percentage of the stainable cells reaches the highest at the end of the first hour Moreover, the cells in division closely follow the total stainable material in the cells, thereby reflecting the definite accumulation of chromatin material in the cells

In the case of niacinless media, there is a gradual building up of chromatin Since there is no direct supply of niacin, it has to be synthesized by other sources and hence perhaps the lag period for attaining the high percentage of the stainable cells

Niacin, so essential a part of the co-enzymes, reflects its basic function in controlling, to some extent, the vital function of the cell, namely its capacity to initiate as well as regulate the division of cells in this yeast

My grateful thanks are due to Mr. M Sreenivasaya for his guidance and to the Council of Scientific & Industrial Research for financing a research scheme of which this work forms a part My sincere thanks are also due to the Director, Indian Institute of Science, for his kind interest.

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Studies in the Fermentation of Carbohydrates by Yeasts—Part II (*Torula* & Other Yeasts)

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The fermentation of 22 carbohydrates by 5 species of *Torula* and 5 others belonging to *Canadia*, *Schizo saccharomyces* and *Rhodotorula* from the National Collection of Type Cultures has been investigated. The *Torulas* do not ferment pentoses but ferment all the mono-saccharides excepting galactose, which is fermented only by N.C.T C. 3057. Sucrose is fermented by all, lactose by N C.T.C. 3057 only and maltose is not fermented by any. Raffinose is feebly fermented by all.

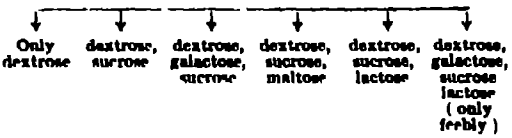
***Rhodotorula* (N.C.T C. 3070) does not ferment any of the carbohydrates. The rest of the yeasts ferment maltose. N C.T C. 3068 ferments dextrin and α-methyl glucoside N.C.T.C. 3066 ferments only dextrin and N.C.T.C. 3067 α-methyl glucoside**

ACCORDING to Guilliermond[1], the *Torulas* and *Mycoderma* are together grouped with wild yeasts These yeasts do not offer any characteristic which permits giving them an accurate status in the classification of fungi In some cases they may represent true yeasts which have become asporogenic The *Torula* includes all yeasts which in liquid media vegetate in the bottom of the culture tube but eventually form a slimy scum with no air bubbles. These are budding yeasts which form no ascus but generally have special cells. Hansen has grouped under *Torula* a large number of asporogenic species often capable of fermenting sugars. Some of them form a red, black or brown pigment The *Torulas* are very widespread in nature and some of them produce a small amount of alcohol and are generally used for food yeast production

Will's *Torula* No 3 and No. 4 ferment dextrose, fructose, galactose and raffinose and others arabinose, glucose, fructose, galactose, lactose, sucrose and maltose

Torula thermantitum ferments xylose, glucose, fructose, mannose, galactose, sucrose, maltose, raffinose, inulin, dextrin and α-methyl-glucoside but not lactose and melibiose.

Key to Species of Torulosis — (a) Fermenting the following sugars


Only dextrose
dextrose, sucrose
dextrose, galactose, sucrose
dextrose, sucrose, maltose
dextrose, sucrose, lactose
dextrose, galactose, sucrose lactose (only feebly)

(b) Non-fermenting

Lastly, mention must be made of the new group called *Rhodotorulaceae* by Lodder He justified the creation of a new family to include the red yeasts on the ground that they are a homogeneous group, all producing carotenoid pigments, which are lacking in other yeasts, none are fermentative and rather inert biochemically

In view of these varied and interesting record of *Torulas* in alcoholic fermentation and carbohydrate utilization, we have recorded here a few of our observations on *Torulas* and *Rhodotorula* and other yeasts (TABLE I)

The cultures belong to the National Collection of Type Cultures, India The method of experimentation was the same as recorded in our two previous papers, in many cases there was vigorous fermentation, some rare carbohydrates were fermented as well

Discussion

Table I records the results for 5 species of *Torula* and *Rhodotorula* and a mixed group of *Canadia* and *Schizo saccharomyces*

(a) The *Torulas* studied are rather restricted in their capacity to ferment sugars, though literature reveals that as many as 12 carbohydrates are fermented by them As in the case of *Saccharomyces*, they do not ferment pentoses

(b) Most of the mono-saccharides are easily fermented to an equal degree except galactose, which is fermented by only one of the *Torulas*.

TABLE I

Carbohydrate	Fermentation by *Torula*					Fermentation by *Rhodotorula* & other yeasts				
	NCTC 3057	NCTC 3009	NCTC 3010	NCTC 3064	NCTC 3065	NCTC 3066	NCTC 3067	NCTC 3068	NCTC 3069	NCTC 3070
Mono saccharides										
Arabinose	—	—	—	—	—	—	—	—	—	—
Rhamnose	—	—	—	—	—	—	—	—	—	—
Xylose	—	—	—	—	—	—	—	—	—	—
Glucose	+++	++++	++++	++++	++++	+++	++++	++++	++++	—
Fructose	++++	++++	++++	++++	++++	++++	++++	++++	++++	—
Galactose	++++	—	—	—	—	+++	++++	—	—	—
Mannose	++++	++++	++++	++++	++++	++++	++++	++++	++++	—
Di saccharides										
Lactose	++++	—	—	—	—	—	—	—	—	—
Sucrose	++++	++++	++++	++++	—	++	++++	++++	++++	—
Maltose	—	—	—	—	—	++	++++	++++	++++	—
Poly saccharides										
Raffinose	++	++	+++	++	—	—	++	+	+	—
Melibiose	—	—	—	—	—	—	++++	—	—	—
Starch	—	—	—	—	—	—	—	—	—	—
Inulin	++++	—	—	—	—	—	—	—	—	—
Dextrin	—	—	—	—	—	+++	—	++	—	—
Glycogen	—	—	—	—	—	—	—	—	—	—
Alcohols										
Mannitol	—	—	—	—	—	—	—	—	—	—
Dulcitol	—	—	—	—	—	—	—	—	—	—
Glucosides										
Amygdalin	—	—	—	—	—	—	—	—	—	—
α methyl glucoside	—	—	—	—	—	—	++++	++++	—	—
β methyl glucoside	—	—	—	—	—	—	—	+	—	—
Salicin	—	—	—	—	—	—	—	—	—	—

— no fermentation + 0 5 cm of gas formation ++ 1 0 cm of gas formation
+++ 1 5 cm of gas formation ++++ 2 0 cm of gas formation

(c) Among the di saccharides lactose is fermented by one of them (N C T C 3057) and not by others Sucrose is easily fermented while none of the *Torulas* ferment maltose In the other group of yeasts all ferment maltose with the exception of *Rhodotorula* (N C T C 3070)

(d) Raffinose is feebly fermented by most of them

(e) Among the *Torulas Torula thermantitolum* ferments inulin In our studies we find that *Torula lactosa* (N C T C 3057) ferments inulin The same is the case with dextrin *Schizo saccharomyces pombe* (N C T C 3068) and *Oidium albicans* (N C T C 3066) both ferment dextrin

(f) *Schizo saccharomyces pombe* (N C T C 3068) and *Zygo saccharomyces priorianus* (N C T C 3067) both ferment methyl glucoside

The *Torulas* in general reveal a restricted field of fermentation mostly confined to a few of the mono saccharides and one or two members of the di saccharides group They are biochemically less active than the *Saccharomyces* The *Rhodotorula* is the most inactive and does not ferment any of the carbohydrates

Our grateful thanks are due to Mr M Sreenivasaya for his guidance and to the Council of Scientific & Industrial Research for financing a scheme of research of which this work forms a part Our sincere thanks are also due to the Director Indian Institute of Science for facilities and for his kind interest

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Fungi Growing on Jute

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Among the fungi growing on raw jute, yarn and hessian, at relative humidities ranging from 100 to 80 per cent, *Aspergilli* and *Penicillia* are very common, *P citrinum* is most conspicuous.

UNDER suitable conditions of moisture and temperature jute is attacked by micro organisms so that the storage and protection of raw jute and jute materials is a considerable problem to the trade An understanding of the type and nature of micro-organisms that are associated with the fibre, therefore becomes necessary even from the purely practical standpoint of devising protective measures

The present work was undertaken to isolate and identify the fungal species that grow — or are found — on jute and jute manufactures Attention was confined to fungi only, since experience has shown that they are the chief destructive agents under usual natural conditions

Experimental

Small quantities of the samples were incubated in closed test tubes containing sulphuric acid solutions with densities adjusted to give the desired relative humidity At intervals, portions of the samples were taken and plated out in the nutrient medium described below The fungi present and their respective colony numbers were recorded in terms of a convenient standard weight of the sample (0 02 gm)

Incubation was carried out at 22°C and at 100, 95, 90, 85 and 80 per cent R H The medium used for plating was made up of Czapek's salt solution (with KH_2PO_4) and 1 per cent glucose to which a hot water extract of jute fibre had been added to make the jute liquor ratio of the final medium 5 100 The medium after sterilization was cooled, acidified with lactic acid to suppress bacterial growth, the sample added, and well mixed by shaking before pouring 25 c c quantities were used in 15 cm petri dishes.

This special medium has some advantages The small amount of sugar present (and also the relatively low depth of medium in the pour plate) discourages extended growth and tends to give small isolated colonies Rapid exhaustion of food favours early sporulation, thus facilitating identification of species jute extract contains various micro nutrients which have marked influence on the growth and sporulation of various cellulose-destroying species[1,2] and in general also accelerate germination

Five samples each of raw fibre yarn and fabric (hessian) were obtained from different sources for these experiments (TABLE I)

Results

The results of these studies are recorded in Tables II VIII

The species of fungi are designated by their laboratory reference numbers and can be identified by reference to Table VIII Attempts to obtain the total colony counts were not always successful as the plates were some times completely over run A blank space in the tables indicates such indeterminate and heavy growth Of the individual species encountered only those which showed evidence of actual increase in growth well over its average count in the unincubated controls were recorded (TABLE II) A rough classification of the vigour of growth was made on the basis of number of colonies per 0 02 gm of the sample as follows heavy, over 1,000, moderate, 1,000 to 100, mild below 100 colonies Species have been reported in the decreasing order of their colony numbers in each column

At 100 per cent R H growth starts quickly and goes on increasing until the end of the test period There is no marked difference in the amount of growth on fibre, yarn and hessian *Penicillium citrinum* was predominant throughout, but less so on hessian Other conspicuous species were 14, 12, 2, 120 and 18 on fibre, 6, 127, 18, 2, P and 120

TABLE I — TYPE & SOURCE OF SAMPLES USED

SAMPLE No	TYPE OF STORE	SOURCE
F1	Fibre white jute middle portion	Chandpur
F2	Fibre tossa jute middle portion	Charmugur a
F3	Fibre white jute bottom portion	Barisal
F4	Fibre white jute middle portion	Narayanganj
F5	Fibre white jute top portion	Nakalla, Pabna
Y1	Yarn 8 lb unsized hessian warp	Jagatdal Jute Mill
Y2		Lachminarayan Jute Mill
Y3		Gourepore Jute Mill
Y4		Gourisankar Jute Mill
Y5		Belvedere Jute Mill
H1	Hessian 11 × 12 10 5 oz./40	Hukumchand Jute Mill
H2		Hooghly Jute Mill
H3		Reliance Jute Mill
H4		Howrah Jute Mill
H5		Kankinarah Jute Mill

TABLE II — TOTAL GROWTH FROM UNINCUBATED CONTROL SAMPLES

(*Expressed on 0 02 gm of sample No heavy growth*)

SAMPLE No	COLONY No	SPECIES APPEARING	
		Moderate growth	Mild growth
F1	40		75 37 6 12 P 2 18 32
F2	414	37	24 120 6 3
F3	7		37 P 44 127
F4	265	37	6 2 120 P
F5	63		4 12 P 3 14 37
Y1	362	37	12 2 2 P 18
Y2	16		P 88 2 6 14 37 75 127
Y3	22		P 2 37 3 12 18
Y4	21		14 P 53 127
Y5	28		6 3 14 P 12 18 37
H1	26		12 14 P 127 6 37, 75
H2	33		88 22 60 10 75 P
H3	34		75 53 6
H4	34		75 88 6
H5	15		75 14 88

on yarn and 88 53 101 126 130 127 18 44 and 132 on hessian Slowly gaining ground were *Penicillium purpurogenum* on yarn and *Penicillium wortmanni* on hessian At 95 per cent R H *P citrinum* was predominant throughout and less so on hessian Also conspicuous were 120 and 44 on fibre 53 6 18 and 127 on yarn and 88 53 127 and 44 on hessian Here also *P purpurogenum* appeared rather late as compared to 100 per cent R H Rate and amount of growth in general did not show a marked fall but the species growing were more limited as evidenced in the comparative rarity of *Aspergillus* species 2 12 and 14 and *Penicillium* species 101 and 132

At 90 per cent R H there was a definite falling off of total growth as compared to 95 per cent and 100 per cent R H at all the incubation intervals studied indicating a distinctly slower rate of growth *P citrinum* was still the predominant infection on fibre and yarn, but on hessian it had given place to *Aspergillus glaucus* which even at the higher R H values was almost as prominent as the former species on hessian These are the only two organisms showing a vigorous growth rate at this R H but also significant are 120 75 88 44 and 18 on fibre and 6 120 75 53 18 2 44 and 128 on yarn The flora growing are more restricted as compared to 100 per cent R H this limiting influence being most noticeable with the species showing similar inhibition between 100 per cent and 95 per cent R H However between 95 and 90 per cent R H there is hardly any difference in the type of species growing with the notable exception of *P purpurogenum* which seems to be inhibited at 90 per cent R H

At 85 per cent R H there is a marked and abrupt fall in growth and after a year s incubation evidence of even mild growth was obtained only in a few isolated instances *P citrinum* is completely supressed and the organisms probably able to grow though extremely slowly are 88 75 53 P and 12 Whether *Trichoderma viride* was actually growing is doubtful

At 80 per cent R H the picture was much the same as at 85 per cent R H Significant increase in growth over the controls was rare even after prolonged incubation except of the Phycomycetes This peculiar Phycomycetous growth at this stage may be due to freedom from competition Other significant species were 88 75 and 44 That some growth takes place though very solwly is indicated by the relative preponderance of *A glaucus* which even at the higher ranges of humidity became increasingly frequent with the lowering of R H Also to be noted is that although at higher humidities *A glaucus* was most frequent on hessian at 80 per cent R H it seems to attack the fibre more easily than yarn or hessian

Discussion

The number of colonies obtained of a given species employing the plating out method is frequently not proportional to total growth as measured by the body weight Thus a species of *Penicillium* or *Mucor* producing large clusters of small spores will give more numerous colonies than a *Curvularia* which produces sporophores bearing only a few spores Nevertheless when interpreted properly the plating out technique can give valuable information and is

TABLE III — SIGNIFICANT GROWTH AT 100 PER CENT R.H.

(*Expressed on 0 02 gm. of sample. Mild growth not reported*)

SAMPLE No.	16 DAYS			31 DAYS			67 DAYS		
	COLONY No.	SIGNIFICANT SPP		COLONY No.	SIGNIFICANT SPP		COLONY No.	SIGNIFICANT SPP	
		Heavy	Moderate		Heavy	Moderate		Heavy	Moderate
F1		37	2, 3, 12		37	2	10,080	37, 18	
F2		37			37		8,680	37	121
F3		37	18		37		12,000	37	
F4		37			37, 2	120	7,320	37, 120	18
F5		14	2, 6, 12, 37	3,725	37, 12	44	4,970	12	14, 2
Y1		37	2, 5, 6		37	6	5,000	37	6, 88, 2
Y2		37, P	2		127	37, 2	4,570	127	37, 6, 18
Y3		37, 6			127	120	2,310	127	6, 2, 12, P
Y4		37, 6, 2			37	120	2,610	127	2
Y5		6, 18			6	5, 53, 2	4,760	6	120, 14, 12, 2, 18
H1		37	2, 3, 6, 44		127		9,680	127	
H2		101		1,320	101	120		182	
H3	336		12, 14		120		8,440	120, 44	
H4		37, 18, 88			53, 88		4,090	37	
H5	96			2,984	126, 88	120, 44	6,820	53	3, 126

TABLE IV — SIGNIFICANT GROWTH AT 95 PER CENT R.H.

(*Expressed on 0 02 gm. of sample. Mild growth not reported*)

SAMPLE No.	27 DAYS			50 DAYS			76 DAYS		
	COLONY No.	SIGNIFICANT SPP		COLONY No.	SIGNIFICANT SPP		COLONY No.	SIGNIFICANT SPP	
		Heavy	Moderate		Heavy	Moderate		Heavy	Moderate
F1		37	18, 44	7,150	37	18	3,360	37	18
F2		37	120		37	120, 24	6,400	37	3, 24
F3		37		4,010	37		9,600	37	
F4		37	120		37		19,600	37, 44	120
F5	2,676	37	12	6,310	37	12, 6, 14	1,920	37	2, 6, 14, 124, P
Y1	5,368	37	6	8,100	37		14,400	37	
Y2	2,052	37		8,350	37	6, 18	7,280	37	127, 5, 14, P
Y3	2,556	37	5, 6	11,720	37	6, 18	1,400	37	2
Y4	2,530	53	18	3,840	37, 18		2,400	37	
Y5	2,960	6			6, 18		9,040	6, 37, 127, 18	
H1	1,448	127	6	12,920	37	120	4,320	37, 127	2, 14
H2	1,320		44, 88, 5	4,070	88				
H3		53		5,040	53	37	16,800	88	37, 44
H4		88, 37		6,020	88		4,000	88	37, 44
H5		37	53	1,150		53, 44, 18	1,600		127, 37, 44, 88

TABLE V — SIGNIFICANT GROWTH AT 90 PER CENT R.H.

(*Expressed on 0 02 gm. of sample. Mild growth not reported*)

SAMPLE No.	36 DAYS			61 DAYS			81 DAYS		
	COLONY No	SIGNIFICANT SPP		COLONY No	SIGNIFICANT SPP		COLONY No.	SIGNIFICANT SPP	
		Heavy	Moderate		Heavy	Moderate		Heavy	Moderate
F1	4,032	37		1,632	37		2,664	37	18
F2	3,272	37			37	120	6,400	37	
F3	196		75	120		37	1,600	37	
F4	348		37, 120		120		200		37
F5	2,128	37	88	684		37, 44	4,080	37	
Y1	1,616	37		1,364	37	75, 120	3,556	37	
Y2	1,096		37	1,306	37		2,016	37	
Y3	504		37	1,092	37		1,054	37	
Y4	672		6, 37	644		53, 37, 120	3,416	37	53, 2, 44, 120
Y5	80			1,956		18, 120, 6	1,728		2, 120, 128, 18
H1	1,600	37		5,136	37		2,040	37	88
H2	480		88	2,240	88		1,280	53	
H3	108			456		88	20		
H4	84			1,200	88		800		88
H5	2,956	88		3,248	88		192		88

the best suited to our purpose namely to isolate the organisms which show signs of growth on jute for further studies using less empirical methods Many of the organisms showing evidence of growth on jute in these tests have also been encountered by us previously in jute materials fresh or rotten and many grow on jute or filter paper in pure culture[8] Notable exceptions are the species of the *Dematiaceae* family which were conspicuously rare in the present tests although some of them like *Curvularia*

TABLE VI — SIGNIFICANT GROWTH AT 85 PER CENT R.H

(*Expressed on 0 02 gm of sample No heavy growth*)

Sample No	50 Days		147 Days			358 Days		
	Colony No	Significant spp mild	Colony No	Significant spp Moderate	Significant spp Mild	Colony No	Significant spp Moderate	Significant spp Mild
F2		24 ?	61		24 ?	12		
F3	3		1			208	12	
Y1	93	75	65			28		
Y3	39			P		21		
Y4	27		45		53	58		
Y5	37		216	88		201	88	
H3	21		23			70		88

TABLE VII — SIGNIFICANT GROWTH AT 90 PER CENT R H.

(*Expressed on 0 02 gm of sample No heavy growth*)

Sample No	59 Days		120 Days	362 Days		
	Significant spp Moderate	Significant spp Mild	Significant spp Moderate	Colony No	Significant spp Moderate	Significant spp Mild
F1				55		88
F2				347	88	44
F4				99	88	
F5				97	88	
Y2	P		P			
Y3	P		P		P	
Y4	P				P	
Y5	P					
H1	P		P			
H4	P	75				

TABLE VIII — FREQUENCY OF INCIDENCE ABILITY TO GROW & RELATION TO R H OF THE FUNGI ENCOUNTERED

IJMARI Ref No	Species	No of times encountered (240 platings)	Evidence of growth	R H at which active
2	*Aspergillus flavus oryzae* Group	66	+	100
3	*Aspergillus niger* Group	50	+	100
5	*Aspergillus flavipes* Group	15	+	95 100
6	*Aspergillus terreus* Group	82	+	90 95 100
10	*Curvularia lunata* (Wakker) Boed ja	1	—	
12	*Aspergillus nidulans* Group	35	+	100 85
14	*Aspergillus fumigatus* Group	57	+	100
18	*Paecilomyces varioti* Bainier	77	+	100 95 90
24	*Trichoderma viride* Pers ex Fries	8	?	95 ? 85 ?
32	*Cladosporium herbarum* (Pers) Link	5	+	100
37	*Penicillium citrinum* Series	123	+	100 95 90
44	*Aspergillus sydowi* Series	41	+	100 95 90 85 ? 80 ?
52	*Penicillium implicatum* Biourge	19	+	100 95 90
60	*Alternaria* sp	1	—	
75	*Chaetomium indicum* Corda	56	+	90 85 ? 80 ?
77	*Penicillium vermiculatum* Dangeard	6	—	
88	*Aspergillus glaucus* Group	72	+	100 95 90 85 80
101	*Penicillium implicatum* Series	3	+	100
120	*Scopulariopsis* sp	37	+	100 95 90
121	*Penicillium variabile* Sopp	8	+	100
124	*Penicillium cyaneum* (B & S) Biourge	8	+	95
125	*Penicillium fellutanum* Biourge	1	—	
126 130	*Penicillium wortmanni* Klocker	12	+	100
127	*Penicillium purpurogenum* Series	19	+	100 95
128	*Penicillium adametzi* Zaleski	1	+	90
132	*Penicillium tardum* Thom	3	+	100
P	Phycomycetes	87	+	100 85 ? 80 ?

and *Alternaria* have frequently been found by us heavily infecting jute materials exposed outdoors. Recent evidence indicates that these dark-coloured fungi grow only when the material is exposed to strong light which destroys the light-coloured fungi[4], the comparatively rare occurrence of the *Dematiaceae* in the present tests would tend to confirm that in the shade they cannot compete with other fungi. These experiments are, therefore, of limited significance so far as a comprehensive evaluation of the total mildew flora of jute is concerned.

In the case of cotton, a large number of fungi have been isolated from damaged stores obtained from different parts of the world[5,6]. Of these there is a large group of organisms, including *Memnoniella* and *Stachybotrys*, which have not been encountered by us on jute either in laboratory tests or on rotten samples obtained from elsewhere. On the other hand, most of the organisms found on jute are encountered on cotton. It would thus seem that the flora of jute, though often of the same type, are numerically more restricted than those of cotton.

Galloway[7] found the critical R.H. at which mildew growth is just inhibited on jute to be 80 per cent. The results reported here confirm this finding but indicate that a few species may grow very slowly even at 80 per cent R.H. This may not be altogether devoid of any significance since jute materials after comparatively long storage have sometimes been found to be mildewed and the humidity at such conditions could not have been high. Of all the species, *A. glaucus* definitely grows at 85 per cent R.H. or below. The low humidity tolerance of this group has been recorded by Galloway[8] and Snow[9]. It is also interesting to note that between the range 100 to 90 per cent R.H., the incidence of *A. glaucus* was in inverse proportion to that of *P. citrinum* on hessian; it may be that some kind of competition occurs between these two organisms. Apart from the preponderance of *A. glaucus* on hessian there was no marked difference between fibre, yarn and hessian, either in the amount or in the kind of growth they supported.

The importance of competition is also manifest in the behaviour of *Chaetomium indicum* which failed to appear at higher levels of humidity, but has been observed to grow well on jute at very high R.H. values under less competitive circumstances. Also, the fact that it can grow at a relatively low R.H. adds to the importance of this fungus which experience has shown to be a serious jute destroyer. The Phycomycetes were encountered often, particularly at 80 per cent R.H., but since other workers have found that they cannot attack cellulose and since our previous work indicated that they grow on extraneous matter on the surface of jute[3] they were not considered to be of much practical significance. *Trichoderma viride* which has often been cited as a strong cellulose-decomposing fungus occurred but rarely, and when it did so it quickly covered the plate in a continuous growth without forming discrete colonies. It was, therefore, not possible to determine whether the organism was actually growing on jute, but in some other tests neither filter paper nor jute fibre was appreciably attacked in pure culture by the strains at our disposal.

Further work designed to get more exact information on the mechanism of the microbiological degradation of jute fibre is being continued with fungi selected on the basis of these studies.

Summary

27 species of fungi, mostly *Aspergilli* and *Penicillia*, were found on raw jute, yarn and hessian samples incubated in shade at humidities ranging from 100 to 80 per cent R.H. *P. citrinum* is most conspicuous. Only 22 of these species appear to be actually growing on the samples.

The number of species growing at 100 per cent R.H. is the largest. Between 100 to 95 per cent R.H. there was a fall in the number of species growing, and between 95 to 90 per cent R.H. total growth was reduced. At 85 and 80 per cent R.H. only a few species were able to grow very slowly. The previous observation that the dark-coloured fungi of the *Dematiaceae* family are inhibited by other species when growth takes place in shade is supported by these results. Competition seems to play a significant part in some instances. Thus *Aspergillus glaucus* and *Chaetomium indicum* occur much more frequently at lower humidities when dominant species like *Penicillium citrinum* are suppressed.

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Investigation on Indian Radioactive Minerals III — Monazite

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Quantitative chemical analysis of monazite shows the mineral to be essentially a cerite earth phosphate

MONAZITE bearing sands were discovered on the Travancore coast by the *London Cosmopolitan Mining Syndicate* in 1909 Tipper states that the mineral occurs in pegmatite intrusions but is probably mainly derived from the gneisses of the Travancore hills Monazite also occurs in India in the sands to the east of Cape Comorin in the Tinnevelly district and again near Waltair A crystalline variety is reported to occur in pegmatites in the Bangalore district Mysore State A large number of beautiful crystals of this mineral have been found with pitchblende and columbite in pegmatites in the Gaya district Bihar It has also been found in minute quantities in Tavoy and Mergui Burma

The present paper deals with the analysis of a specimen of the mineral collected by Tipper from Pichhli Gaya district Bihar The mineral was a semi transparent shining light brownish yellow coloured sample with resinous lustre hardness 5 5 5 and specific gravity 5 1

Method of Analysis

The sample was crushed to pieces of ⅛" ¼" in diameter purified from slimy impurities by repeated washing and decantation with water from any decomposition product by treatment with very dilute nitric acid for 48 hr washing with distilled water and finally drying at 110°C The purified sample was powdered to pass through a 200-mesh sieve and the analysis was carried out according to the Scheme I

Several determinations of uranium were carried out and the results were found to be almost identical The analytical procedure is given in Scheme II

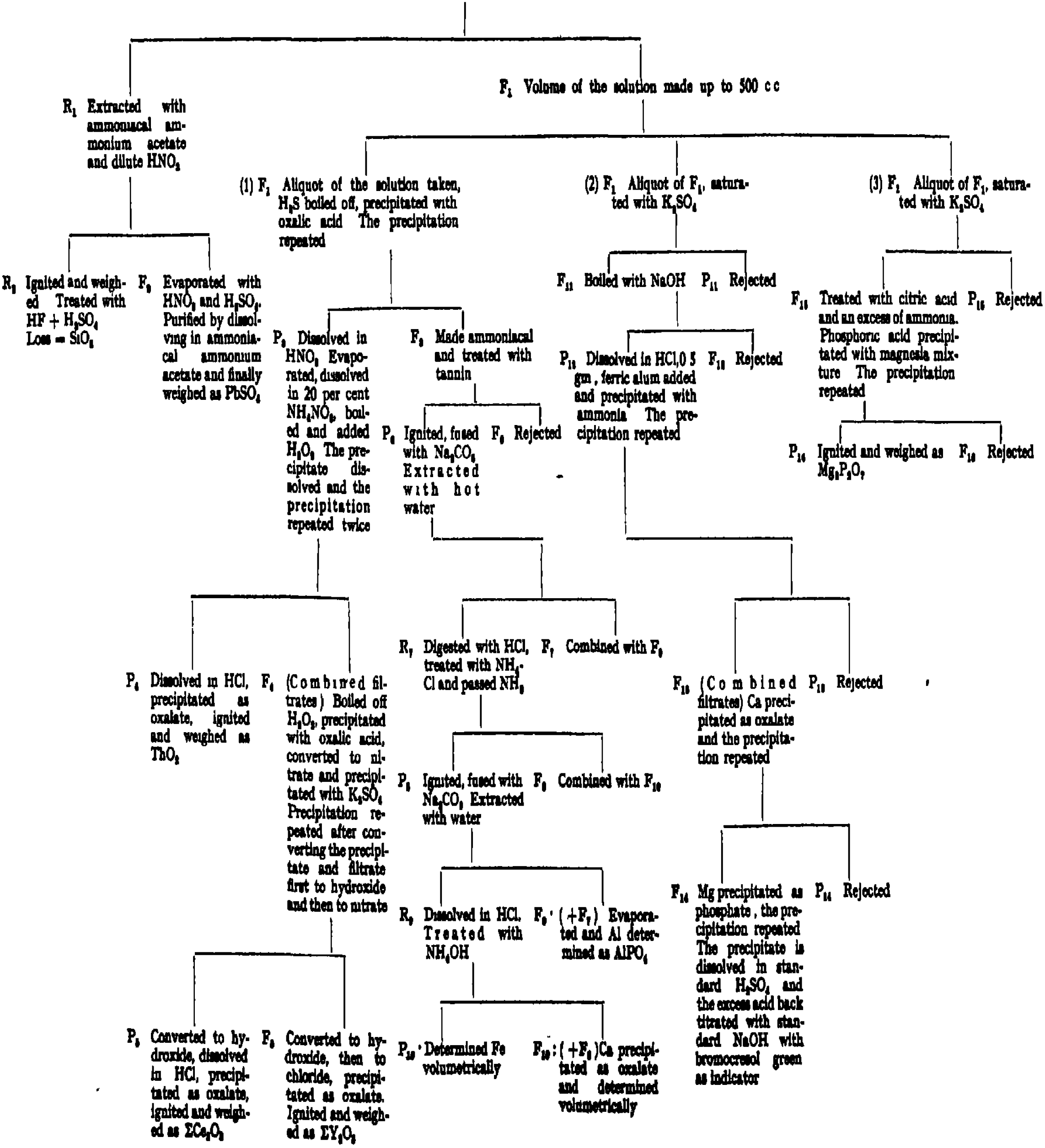
Estimation of cerium praseodymium neodymium samarium and lanthanum were carried out according to the method described in the previous paper[1]

The mean values from a duplicate analysis of the mineral are given below

The separation of the rare earths into cerium and yttrium earth groups by the double sulphate method is not sharp Traces of neodymium and appreciable amount of samarium fail to precipitate as double sulphates and hence the value of the yttrium earths may be little too high On the other hand the value of cerium earths may be a little too low The spectrographic examinations of the yttrium earth fraction gave strong lines of Dy Ho Tm Yb Lu Y Er Gd Tb Eu and Sm (a member of cerium earth group) and very faint lines of Ce La Nd (members of the cerium earth group)

SCHEME I

5 gm of the mineral was decomposed with conc. H_2SO_4, the decomposed mass dissolved in ice-cold water The solution was saturated with H_2S. Filtered and insoluble mass washed with cold 5 per cent H_2SO_4, saturated with H_2S



R_1 Extracted with ammoniacal ammonium acetate and dilute HNO_3

R_2 Ignited and weighed Treated with $HF + H_2SO_4$ Loss = SiO_2

F_2 Evaporated with HNO_3 and H_2SO_4. Purified by dissolving in ammoniacal ammonium acetate and finally weighed as $PbSO_4$

F_1 Volume of the solution made up to 500 c c

(1) F_1 Aliquot of the solution taken, H_2S boiled off, precipitated with oxalic acid The precipitation repeated

P_3 Dissolved in HNO_3 Evaporated, dissolved in 20 per cent NH_4NO_3, boiled and added H_2O_2 The precipitate dissolved and the precipitation repeated twice

F_3 Made ammoniacal and treated with tannin

P_6 Ignited, fused with Na_2CO_3 Extracted with hot water

F_6 Rejected

P_4 Dissolved in HCl, precipitated as oxalate, ignited and weighed as ThO_2

F_4 (Combined filtrates) Boiled off H_2O_2, precipitated with oxalic acid, converted to nitrate and precipitated with K_2SO_4 Precipitation repeated after converting the precipitate and filtrate first to hydroxide and then to nitrate

P_5 Converted to hydroxide, dissolved in HCl, precipitated as oxalate, ignited and weighed as ΣCe_2O_3

F_5 Converted to hydroxide, then to chloride, precipitated as oxalate. Ignited and weighed as ΣY_2O_3

R_7 Digested with HCl, treated with NH_4Cl and passed NH_3

F_7 Combined with F_9

P_8 Ignited, fused with Na_2CO_3 Extracted with water

F_8 Combined with F_{10}

R_9 Dissolved in HCl. Treated with NH_4OH

F_9 ($+F_7$) Evaporated and Al determined as $AlPO_4$

P_{10} Determined Fe volumetrically

F_{10}: ($+F_8$) Ca precipitated as oxalate and determined volumetrically

(2) F_1 Aliquot of F_1, saturated with K_2SO_4

F_{11} Boiled with NaOH

P_{11} Rejected

P_{12} Dissolved in HCl, 0 5 gm, ferric alum added and precipitated with ammonia The precipitation repeated

F_{12} Rejected

F_{13} (Combined filtrates) Ca precipitated as oxalate and the precipitation repeated

P_{13} Rejected

F_{14} Mg precipitated as phosphate, the precipitation repeated The precipitate is dissolved in standard H_2SO_4 and the excess acid back titrated with standard NaOH with bromocresol green as indicator

P_{14} Rejected

(3) F_1 Aliquot of F_1, saturated with K_2SO_4

F_{15} Treated with citric acid and an excess of ammonia. Phosphoric acid precipitated with magnesia mixture The precipitation repeated

P_{15} Rejected

P_{16} Ignited and weighed as $Mg_2P_2O_7$

F_{16} Rejected

SCHEME II

5 gm of powdered mineral decomposed with 5 c c HF and 15-20 c c H_2SO_4 Heated to strong fumes of SO_3 for 6 hr Taken up with cold water and made up to 250 c c Added K_2CO_3 crystals until most of the acid was neutralized Warmed, filtered and washed with hot strong K_2SO_4 solution

F_1	Boiled to expel CO_2, added NH_4OH in small excess. Filtered and washed with 2 per cent NH_4NO_3 solution	P_1	Rejected
F_2	Washed into a platinum basin, treated precipitate and paper with weak HF Evaporated to a small volume Filtered off the precipitate of fluorides of Th and rare earths and washed with warm HF	F_2	Rejected
F_3	Added 5 c c. H_2SO_4 and evaporated to heavy fumes. Taken up with water, heated and cooled, volume made up to 150 c c, added excess of K_4FeCN_6 solution and saturated with NaCl Let stand for several hours, filtered and washed with strong solution of NaCl	P_3	Rejected
P_4	(of ferrocyanides of U and Fe) Digested with cold dilute NaOH until all ferrocyanide was converted to hydroxide Washed with 2 per cent NH_4Cl and a little ammonia	F_4	Rejected
P_5	Dissolved in HCl, volume made to 300 c c Neutralized with Na_2CO_3 and added 2 gm excess Boiled and filtered, washed with hot 2 per cent NH_4NO_3	F_5	Rejected
F_6	Acidified with HCl and boiled off CO_2 Added NH_4OH in excess Boiled and filtered	P_6	Rejected
P_7	Dissolved in HNO_3, made ammoniacal, added a solution of $(NH_4)_2CO_3$ in ammonia Allowed to stand for 2 hr Filtered	F_7	Rejected
F_8	Boiled the solution to expel CO_2 and NH_3. Saturated with H_2S after acidification Filtered	P_8	Rejected
F_9	Boiled off H_2S Made faintly acid with HNO_3 Boiled Through the hot solution passed ammonia in excess Filtered and washed with 2 per cent NH_4NO_3	P_9	Rejected
P_{10}	Ignited and weighed as U_3O_8 Dissolved in warm 1 1 HNO_3 and filtered	F_{10}	Rejected
P_{11}	Ignited and weighed Subtracted the weight from the weight of U_3O_8 found	F_{11}	Rejected

Alternately (as used in duplicate analysis) uranium was determined as $UO_2(C_9H_6NO)_2C_9H_7NO$

Chemical Composition

The analytical results show that the mineral is essentially a cerite earth orthophosphate. The sum of the equivalent ratios of the acidic constituents to that of the basic constituents is found to be unity

Much work has been done by previous workers on the rôle of thorium in monazite The first explanation due to Dunnington[2] is that $ThSiO_4$ is mechanically mixed with monazite Penfield[3] supported this view and found that the ratio of ThO_2 $SiO_2 = 1$ and P_2O_5 $R_2O_3 = 1$. Blomstrand[4] disputed Penfield's observations and concluded that thoria is present partly with silica and partly with P_2O_5 Kress and Metzger[5], after an exhaustive investigation, came to the conclusion that thorium is present as phosphate with some admixed silicate, e g feldspar The present investigation shows that the amount of silica is quite insufficient to combine with the whole of thorium ($SiO_2 . ThO_2 = 0{\cdot}52$) On the other hand, the rare earths alone are not sufficient to satisfy the ratio R_2O_3 $P_2O_5 = 1$ Thorium is, therefore, present partly with silica and partly with phosphate According to Goldschmidt, a

ANALYSIS OF MONAZITE FROM GAYA

	%
P_2O_5	27 38
MgO	0 10
PbO	0 58
SiO_2	1 43
CaO	0 82
Fe_2O_3	0 49
Al_2O_3	0 74
ThO_2	11 98
ΣY_2O_3	3 05
ΣCe_2O_3	51 94
U_3O_8	0 28
Loss on ignition	0 67
Total	99 89
Pb ratio	0 116
Ce_2O_3	28 86
Pr_2O_3	3 50
Nd_2O_3	7 40
Sm_2O_3	2 30
La_2O_3	14 88

particular crystal may take up ions of another element which have about the same ionic radius but a different charge and it is easier for a mineral to take up an ion of greater rather than smaller charge Thus $\mathrm{Th}^{\mathrm{iv}}$ (radius 1 10Å) has replaced $\mathrm{Ce}^{\mathrm{iii}}$ (1 18Å) and $\mathrm{SiO}_4^{''''}$ has partially replaced P_4 so that it is quite possible that some thorium is with phosphate and some with silicate

Age of the Mineral

The mean values obtained for lead uranium and thorium were taken for the determination of the geological age of the mineral After substituting these values in Holmes and Lawson s modified formula the age of the mineral was found to be 803 million years indicating that the mineral is of upper Pre-cambrian era

Acknowledgement

Our thanks are due to Prof P B Sarkar for his keen interest in the work and to the Council of Scientific & Industrial Research for a research grant We are also thankful to the Director Geological Survey of India for supplying the mineral

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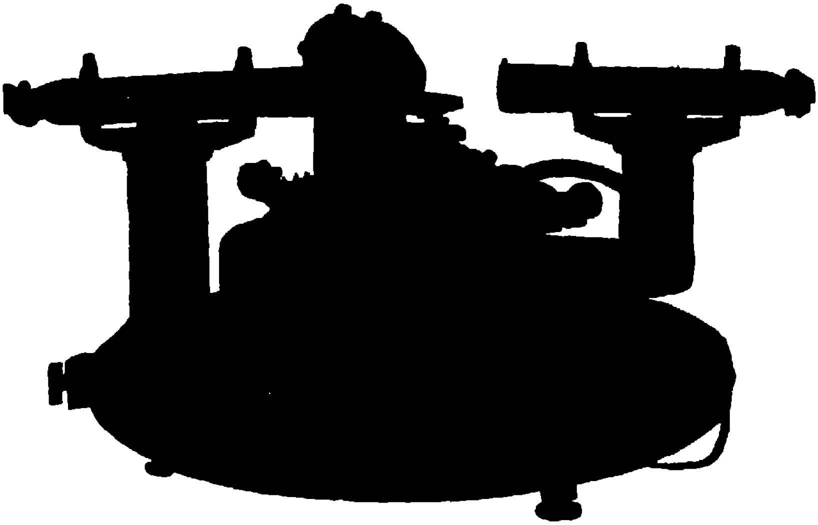

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Alkaloidal Constituents of the Bark of B *aristata (Rassaut)*

K K CHAKRAVARTI D C DHAR & S SIDDIQUI
Chemical Laboratories C S I R Delhi

Berberine berberine chloride and palmatine have been isolated from the alcoholic extract of the bark of *Berberis aristata*

ABOUT 13 species[1] of Berberis occur in India mostly in the Himalayan region and in Assam Four of them also occur in Central India and the Nilgiris and one variety of B *asiatica* Roxb in the Parasnath Hills of Chota Nagpur Some of these species are not easily distinguishable from one another and considerable difficulty is experienced in their identification particularly because most of the berberis species are known by the same Indian name and are reputed for similar therapeutic properties Berberis roots and bark are employed in the indigenous systems of medicine as bitter tonics and stomachics The aqueous extracts of the roots serve as a household remedy in acute conjunctivities in chronic opthalmia and also in the treatment of oriental sores More recently the principal alkaloid of the drug namely berberine has been shown to possess antibiotic activity[2]

In view of the facts stated above it was considered of interest to undertake a systematic study of the alkaloidal constituents of the various Indian species of berberis The present paper deals with a study of the alkaloids from the bark of B *aristata* obtained from Kangra (Punjab) Earlier work[3] on this species of berberis was limited to the isolation of berberine (yield 2 23 per cent) and a minute quantity of the oxalate of an unidentified base As a result of the present investigation three naturally occurring crystalline yellow-coloured salts of bases melting at 235°C 220°C and 165°C respectively (decomp) have been obtained by a process of fractionation of the initial crystallizate from the alcoholic extract of the bark on the basis of varying solubilities of the native salts in various organic solvents and water The mother liquors of these natural salts all of which proved to be chlorides further gave berberine through the chloride and a crystalline iodide orange yellow needles m p 241°C (decomp) The total yield of the alkaloids in the form of salts amounted to *c* 4 per cent on the weight of the dry powdered bark

The nitrate prepared from the natural chloride m p 220°C (decomp) (Cl 9 24 per cent) analysed for $C_{20}H_{18}N_2O_7$ and gave the characteristic colour reactions of berberine It formed an acetone compound m p 175°C identical with the anhydro berberine acetone prepared from berberine chloride The natural chloride on reduction gave a colourless base m p 170°C which analysed for $C_{20}H_{21}O_4N$ and gave no depression in melting point with tetrahydro anhydro berberine prepared from berberine chloride The native salt melting at 220°C (decomp) was thus established as berberine chloride

The iodide m p 241°C (decomp) analysed for $C_{21}H_{22}O_4NI$ $2H_2O$ and gave methoxyl value for 4 methoxyl groups It gave the chloride in the form of greenish yellow needles $C_{21}H_{22}O_4NCl$ $3H_2O$ m p 205°C (decomp) and the nitrate yellow needles $C_{21}H_{22}O_7N_2$ 1 5 H_2O m p 239°C (decomp) The analysis and melting points of these salts agreed with those of the corresponding salts of palmatine From the chloride a colourless crystalline base, $C_{21}H_{24}O_4N$, was obtained on reduction and the reduced base was found to be identical in melting point with that of tetrahydro-anhydro-palmatine. Although a mixed melting point of the reduced base (m p 147°C) with tetrahydropalmatine could not be taken owing to the lack of a sample of palmatine, the data presented above leave little doubt as to the identity of the iodide of the base isolated from *Berberis aristata* with palmatine iodide

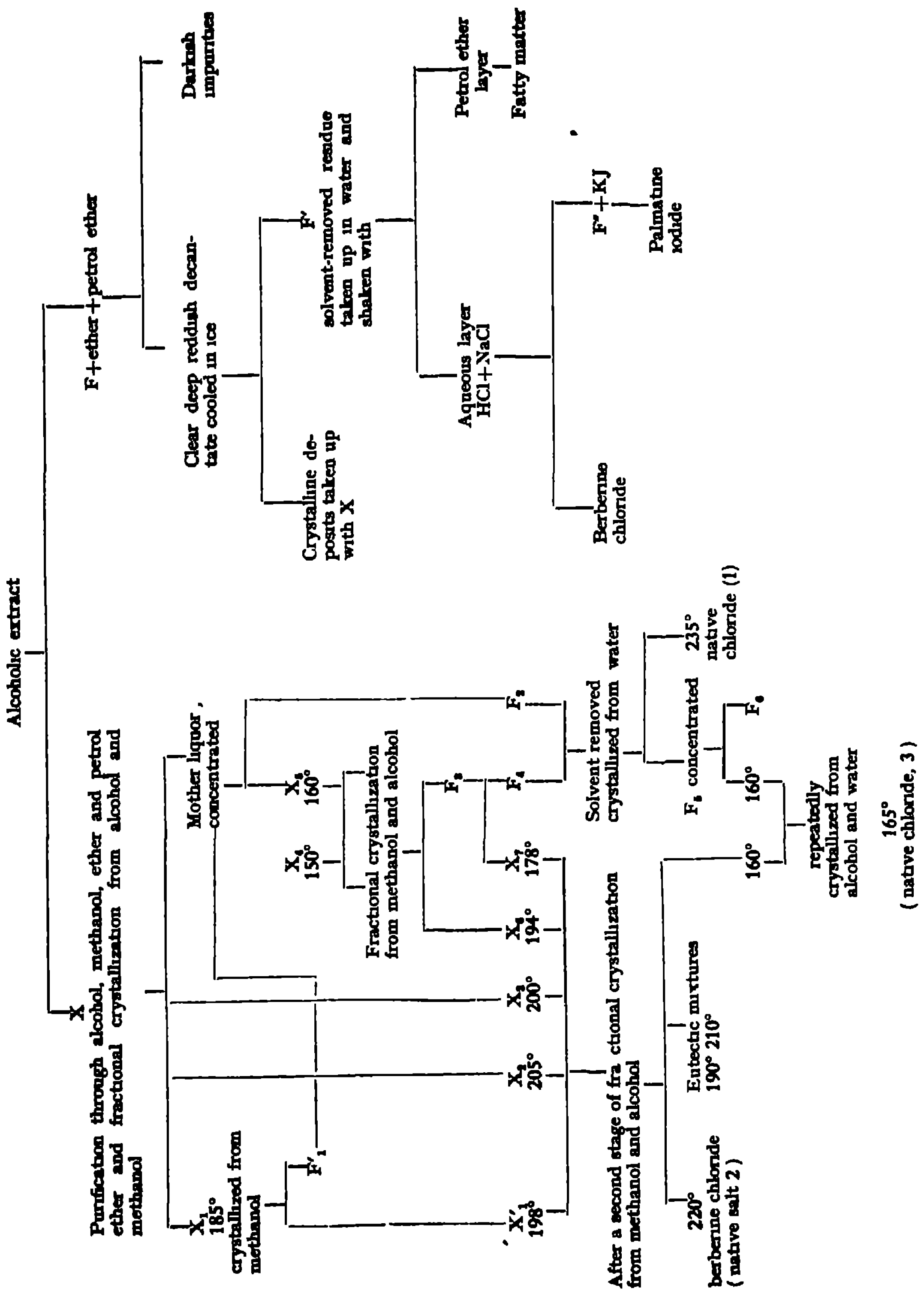
Results of studies of the natural chlorides melting at 235°C (decomp) and 165°C (decomp) will be communicated in a subsequent paper

Experimental

7 kg of well-powdered bark were percolated 4 times with alcohol and the combined percolates concentrated below 50°C *in vacuo* to a soft extract, which was of a dark yellowish colour After keeping the concentrated extract for 2 weeks, the initial crystallizate (X) was filtered, washed with cold water and dried on the porous plate (filtrate and washings, marked F in the CHART)

Purification of Initial Crystallizate (X) — 100 gm of the crude yellowish-brown crystallizate (X) were well powdered, digested with water in the hot and filtered The undissolved reddish-yellow residue was extracted with hot alcohol and the alcohol-insoluble portion was dissolved in a mixture of alcohol and methanol (1 1) The alcoholic solution was treated with a little ether and petrol ether which removed dark reddish impurities, leaving a clarified liquid from which a light reddish coloured crystallizate (X_1), m p 185°C (decomp), was obtained on the addition of excess of ether The filtrate from the ethyl alcohol-insoluble fraction of the initial crystallizate was allowed to stand for sometime in the cold and the yellow crystalline mass (X_2), m p 205°C (decomp), which separated out was filtered and washed with alcohol The filtrate was then concentrated to a small volume, when it gave a further quantity of a yellow crystalline product (X_3), m.p. 200°C. (decomp). The mother liquor from (X_3) gave on treatment with ether a crystalline precipitate (X_4) which melted at 150°C. By this method of initial purification and fractionation 4 crystallizates were obtained, the melting points of which ranged from 205°C. down to 150°C. in the case of the last fraction After a second stage of fractional crystallization (*vide* CHART), the higher melting fractions (m.p 178°-205°C.) were again fractionally crystallized from methanol and alcohol, when they finally gave a product from the top fractions which melted at 220°C. (decomp) The filtrates obtained in the course of initial fractionation of the crystallizates (F_4 and F_3) were freed of the solvent by evaporation in smaller lots, the residues were dissolved in water, the solution treated with activated charcoal, filtered and allowed to crystallize, when a product melting at 230°C. was obtained which, on repeated recrystallization from alcohol, finally melted at 235°C The intermediate fractions melting between 210°C and 190°C obtained in the course of fractional crystallization of crops melting from 178°C to 205°C were set aside for the present, as they appeared to constitute intractable eutectic mixtures. From the combined tail fractions from this side and from the mother liquors of the fraction melting at 235°C (m p 150°-60°C), repeated crystallizations from alcohol and water ultimately led to a third definitely uniform product, which melted at 165°C and the melting point of which could not be raised higher on further crystallization from these solvents

Isolation of Berberine & Palmatine from the Mother Liquors (F) of the Initial Crystallizate — The alcoholic filtrate (F) from the initial crystallizate of the native salts was purified by the addition of ether and petrol ether, which precipitated out a dark brownish sticky mass The clear deep reddish decantate was freed of the solvent and the residue was taken up in about 500 c c water and shaken out repeatedly with petrol ether to remove fatty matter. The yellow-brown aqueous layer was acidified with hydrochloric acid and treated with sodium chloride to saturation. The heavy yellow precipitate was filtered, well washed with cold water, dried on a porous plate (125 gm) and repeatedly crystallized from alcohol and water, when berberine chloride, m p. 220°C. (decomp.), was ultimately obtained. The filtrate from crude berberine chloride was treated with potassium iodide and the orange-yellow ppt was filtered, washed with cold water, dried (50 gm.) and repeatedly crystallized from a mixture of methanol and 10 per cent


Alcoholic extract
F+ether+petrol ether
Darkish impurities
Clear deep reddish decantate cooled in ice
Crystalline deposits taken up with X
F'
solvent-removed residue taken up in water and shaken with
Petrol ether layer
Fatty matter
Aqueous layer HCl+NaCl
Berberine chloride
F''+KJ
Palmatine iodide
X
Purification through alcohol, methanol, ether and petrol ether and fractional crystallization from alcohol and methanol
X1 185° crystallized from methanol
F'1
X'1 198°
Mother liquor, concentrated
X2 205°
X3 200°
X4 150°
X5 160°
Fractional crystallization from methanol and alcohol
F2
F3
X6 194°
X7 178°
F4
Solvent removed crystallized from water
235° native chloride (1)
F5 concentrated
F6
160°
160°
repeatedly crystallized from alcohol and water
165° (native chloride, 3)
After a second stage of fractional crystallization from methanol and alcohol
Eutectic mixtures 190° 210°
220° berberine chloride (native salt 2)

acetic acid when it finally melted at 241°C (decomp) (CHART) Found C, 48 65, H, 5·25, N, 2 90 per cent; OMe, 23·82, I, 24·12 per cent, required for $C_{21}H_{22}O_4NI$, $2H_2O$ (palmatine iodide) C, 48·93, H, 5·04, N, 2·72, OMe, 24·66, I, 24·07 per cent

Characterization of the Natural Alkaloidal Salts — The aqueous solution of the natural salt melting at 220°C was treated in the hot with a saturated solution of KNO_3, and the crystalline nitrate of the base which came out on cooling was filtered Addition of silver nitrate solution to the filtrate gave the curdy-white precipitate of silver chloride The salts melting at 235°C and 165°C also showed a similar behaviour and all the natural salts were thus proved to the chlorides

Nitrate from the Natural Salt (m p 220°C) Berberine Nitrate — The nitrate prepared from the natural salt in the manner described above or by warming an aqueous solution of it with dilute nitric acid was repeatedly crystallized from water, when it was finally obtained as fine yellow needles, m p 275°C (decomp) Found C, 59·92, H, 4 67, N, 7 12 per cent, required for $C_{20}H_{18}N_2O_7$ C, 60 30, H, 4 52, N, 7 04 per cent

Acetone compound, prepared according to the prescribed method, melted at 175°C, and its mixed melting point with an authentic sample of the acetone compound of berberine showed no depression in a parallel observation of the melting points

Reduction of Natural Salt (m p 220°C) Tetrahydro-berberine — 2 gm of the natural salt were catalytically reduced with platinum oxide in methanol solution The residue left over after filtration from platinum oxide and evaporation of the solvent was treated with fairly concentrated ammonia to liberate the reduced base, which was filtered, washed with cold water, dried and crystallized from a mixture of benzene and petroleum ether, colourless needles, soluble in benzene, insoluble in petrol ether and ether were obtained, m.p. 170°C.; yield, 1·8 gm. Found C, 70·28, H, 5 92, N, 4·01 per cent; required for $C_{20}H_{21}O_4N$ C, 70·8, H, 6·19, N, 4·12 per cent.

Palmatine Chloride — 5 gm. of iodide melting at 241°C. were treated in methanol medium with an excess of freshly precipitated silver chloride and the pasty mass extracted with methyl alcohol and filtered. The filtrate was freed of the solvent, taken up in a little warm alcohol from which palmatine chloride crystallized out in orange-yellow needles, m p 205°C (decomp) Found Cl, 7·99 per cent, required for $C_{21}H_{22}O_4NCl$, $3H_2O$ Cl, 8 04 per cent.

Palmatine Nitrate — 0·2 gm. of the chloride was treated with 5 c c of dil nitric acid, when the nitrate of the base came out as a yellow crystalline mass, which crystallized from water in greenish yellow needles, m p 245°C (decomp) Found C, 56 10, H, 6 01, N, 6 46, OMe, 23 4 per cent, required for $C_{21}H_{22}O_7N_2$, $1\frac{1}{2}H_2O$ C, 57 14, H, 5 66, N, 6 35, OMe, 24 07 per cent

Tetrahydro-palmatine — 2 gm of the chloride reduced with platinum oxide in methanol solution and worked up in the manner described in the case of tetrahydroberberine gave the reduced base in the form of colourless needles, soluble in alcohol, methyl alcohol, chloroform, sparingly soluble in ether, and insoluble in petrol ether, m p. 147°C, yield, 1 7 gm Found, C, 71 18, H, 6 77, N, 3 95 per cent, required for $C_{21}H_{24}O_4N$ C, 71·02, H, 6 98, N, 4·13 per cent

Our thanks are due to Mr Baldev Singh for his help in providing the plant material and to Mr S C Misra for his assistance in the initial stages of the isolation work

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Studies in the Syntheses of Quinolino-α-Pyrones—Part I

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The syntheses of 4-hydroxy-quinaldino-6-5-α-pyrone ($C_{12}H_9O_3N$), (2 : 3-cyclopenteno)-4-hydroxy-quinolino-6 : 5-α-pyrone ($C_{15}H_{11}O_3N$) and (2 : 3-cyclohexeno)-4-hydroxy-quinolino-6-5-α-pyrone ($C_{16}H_{13}O_3N$) have been effected by the application of Conrad and Limpach reaction.

IN view of the physiological activity characterizing both coumarins and alkaloids, it was considered of interest to synthesize and study the physiological activity of compounds containing both the lactone group of the coumarins and the basic nitrogen system of the alkaloids Some compounds of this type, viz quinolino-6 5-α-pyrone, have already been synthesized by Dey *et al* by the application of the Skraup's reaction to 6-aminocoumarin[1] and also by applying the Doebner-Miller reaction to 6-aminocoumarin, 6-amino-4-naphthopyrone[2], 5-amino-8-methoxycoumarin and 6-amino-8-methoxycoumarin[3], but no mention of their physiological activity is available in literature

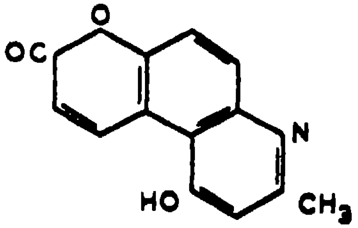
In the present investigation, 4-hydroxy-quinaldino-6 : 5-α-pyrone, $C_{12}H_9O_3N$ (I), (2 3-cyclopenteno)-4-hydroxy-quinolino-6 : 5-α-pyrone, $C_{15}H_{11}O_3N$ (II) and (2 3-cyclohexeno)-4-hydroxy-quinolino-6 5-α-pyrone, $C_{16}H_{13}O_3N$ (III) have been synthesized. These bases have been prepared by the cyclization of the intermediate products, ethyl-3'-(6-aminocoumarin)-crotonate, $C_{15}H_{15}O_4N$ (IA), ethyl-5'-(6-aminocoumarin)-1' 5'-cyclopentene carboxylate, $C_{17}H_{17}O_4N$ (IIA) and ethyl-6'-(6-aminocoumarin)-1' 6'-cyclohexene carboxylate, $C_{18}H_{19}O_4N$ (IIIA) obtained by the condensation of 6-aminocoumarin with ethyl acetoacetate, ethyl-cyclopentanone-2-carboxylate and ethyl-cyclohexanone-2-carboxylate respectively, under conditions which exclude the formation of the corresponding anilides, according to the method of Conrad and Limpach[4] Angular structures have been assigned to these bases in consideration of the observations of Dey and Goswami[1]

The bases have been obtained in good yields They give copious precipitates with the usual alkaloidal reagents and respond to the characteristic colour reactions of alkaloids The basic nature of these substances is not prominent owing to the presence of a phenolic hydroxyl group, which gives them an amphoteric character and is responsible for their solubility in dilute alkalies The weak basic character is also responsible for the ease with which the hydrochlorides get hydrolysed in the presence of water Further work in this line is in progress

Experimental

Ethyl - 3' - (6 - aminocoumarin) - crotonate, $C_{15}H_{15}O_4N$ (IA) — A mixture of 6-aminocoumarin (2 1 gm) and ethyl acetoacetate (2 7 gm) was warmed on the water bath and the resulting solution kept overnight after adding a drop of 50 per cent hydrochloric acid, in a flask fitted with calcium chloride guard tube The condensation product which separated as a white crystalline mass was collected, washed with 5 per cent sodium hydroxide solution (50 c c) and washed free of alkali It crystallized from dilute alcohol in white plates, m.p 126°C, yield, 70 per cent Found N, 5 06 per cent, $C_{15}H_{15}O_4N$ requires N, 5·13 per cent

4-hydroxy-quinaldino-6 5-α-pyrone, $C_{12}H_9O_3N$ (I) — 40 c c of liquid paraffin was heated to 260°C. and 1 gm of the intermediate (IA) was quickly added on to it, the heating being continued for 1 min. at a temperature range of 260°-70°C It was then allowed to cool down to the room temperature, diluted with a little petrol ether The resultant product was filtered, washed with petroleum ether, dissolved in hydrochloric acid and precipitated with ammonia after filtering off the suspended



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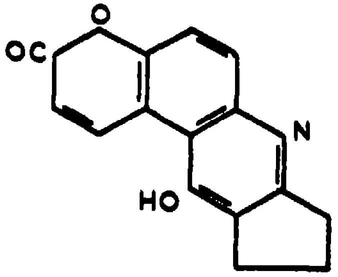

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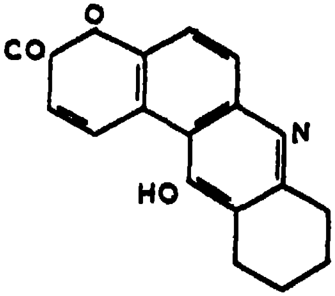

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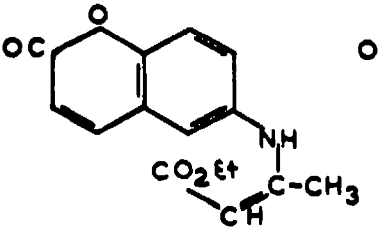
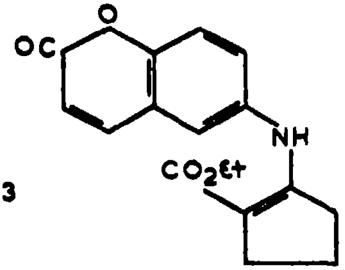
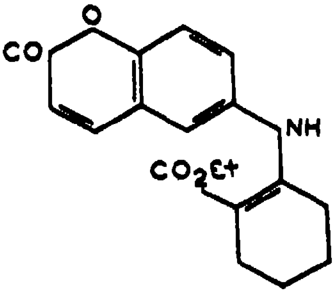


IA



IIA



IIIA

impurities The base thus obtained crystallized from absolute alcohol in light-yellow needles, m p 312°C (decomp) It is sparingly soluble in benzene and ethyl acetate, fairly soluble in absolute alcohol, moist acetone, xylene and cyclohexanone, insoluble in ether and petroleum ether, yield 90 per cent Found N, 6 21 per cent, $C_{13}H_9O_3N$ requires N, 6·17 per cent

The *hydrochloride* obtained by dissolving the base in concentrated hydrochloric acid and evaporating off the acid, formed white crystalline needles which, after washing with alcohol, melted at 250°C (decomp) The hydrochloride is sparingly soluble in alcohol, insoluble in other organic solvents and is unstable in water

The *chloroplatinate* obtained by adding a 2 per cent solution of platinic chloride to a solution of the base in fairly concentrated hydrochloric acid, formed buff-coloured needles melting at 280°C (decomp)

The *picrate* was prepared by adding a saturated solution of picric acid in glacial acetic acid to the base dissolved in a little of the same solvent It formed deep-yellow rhombic crystals, m p 283°C (decomp)

Ethyl-5′-(6-aminocoumarin)-1′ 5′-cyclopentene carboxylate, $C_{17}H_{17}O_4N$ (IIA) — To a clear solution of 6-aminocoumarin (1 08 gm) in cyclopentanone carboxylic ester (1 30 gm), obtained by warming the mixture on a water bath, a drop of 50 per cent solution of hydrochloric acid was added and the solution kept in the flask fitted with a calcium chloride guard tube for 12 hr The separated crystals were filtered, washed first with 5 per cent sodium hydroxide solution and then repeatedly with water On re-crystallization from alcohol the product formed pale-yellow rods, m p 153°C, yield, 90 per cent Found N, 4 67 per cent, $C_{17}H_{17}O_4N$ requires: N, 4 68 per cent.

(2 3-*Cyclopenteno*)-4-*hydroxy-quinolino*-6 5-*α-pyrone*, $C_{15}H_{11}O_3N$ (II) — The intermediate (IIA) was cyclized by following the procedure noted for base I The resulting base crystallized from absolute alcohol in cream-coloured needles, m.p.

330°C (decomp). It is sparingly soluble in benzene and ethyl acetate and fairly soluble in absolute alcohol and cyclohexanone, yield, 60 per cent Found N, 5·60 per cent, $C_{15}H_{11}O_3N$ requires N, 5 53 per cent.

Hydrochloride — Colourless hexagonal plates, m.p. 360°C. (decomp)

Chloroplatinate — Brownish-yellow hexagonal plates, m p 250°C (decomp)

Picrate — Deep-yellow rhombic crystals, m.p. 238°C (decomp)

Ethyl-6′-(6-aminocoumarin)-1′ 6′-cyclohexene carboxylate, $C_{18}H_{19}O_4N$ (IIIA) — 6-Aminocoumarin (0 3 gm) was heated on a water bath with an excess of cyclohexanone carboxylic ester (0 5 gm) for 2 hr and the resultant solution left overnight after adding a drop of 50 per cent hydrochloric acid The solid mass which separated was treated with sodium hydroxide solution (5 per cent), filtered, washed free of alkali and crystallized from alcohol, pale-yellow needles, m p 132°C , yield, 95 per cent Found N, 4 50 per cent, $C_{18}H_{19}O_4N$ requires N, 4·47 per cent

(2 3-*Cyclohexeno*)-4-*hydroxy*-*quinolino*-6 5-*α*-*pyrone*, $C_{16}H_{13}O_3N$ (III) — 0 3 gm of the intermediate (IIIA) was added to liquid paraffin (20 c.c) heated to 270°C and kept at that temperature for 5 min The dark-brown product which separated out after the initial solution of the intermediate was filtered after cooling down to room temperature and dilution with a little petrol ether and washed with petrol ether The product thus obtained was warmed with a little conc hydrochloric acid and filtered from the non-basic, insoluble, darkish resinous matter The filtrate was cooled after dilution with twice its volume of water, and then treated with excess of ammonia. The precipitated base was filtered, washed, dried on a porous plate and crystallized from absolute alcohol It forms pale-yellow needles, m.p 330°C (decomp), is fairly soluble in hot cyclohexanone and sparingly in benzene and ethyl acetate, yield, 70 per cent Found N, 5·32 per cent, $C_{16}H_{13}O_3N$ requires N, 5 24 per cent

Hydrochloride — White rhombic crystals, m p 285°C (decomp)

Chloroplatinate — Buff-coloured needles, m p 241°C. (decomp)

Picrate — Yellow rhombic crystals, m p. 210°C

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Optical Rotation of Abietic Acid in Alcohols

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The optical rotation of abietic acid from Indian rosin in monohydric alcohols has been determined The specific rotation of abietic acid in methyl, ethyl and *iso*-amyl alcohols increases with the concentration of the acid; in the case of other alcohols the rotation increases up to a point beyond which it falls.

MITRA and Ghatak[1] and Rau and Simonsen[2] have shown that abietic acid is the chief constituent of Indian rosin obtained from *Pinus longifolia* The physical properties (but not the chemical properties) of abietic acid depend upon the method employed for its preparation and purification[3]. Optical rotation is the most important physical constant of abietic acid and is often quoted to the exclusion of all others.

The optical rotation of abietic acid from Indian rosin in monohydric alcohol solvents has been determined. The results obtained are recorded in this paper

Experimental

Abietic acid was prepared from "water-white rosin" (*Jallo Rosin & Turpentine Factory*, Lahore) by distillation with super-heated steam[3] Freshly powdered sample of rosin, m p 160°-63°C, was used, as powdered rosin on storage gets oxidized. The acid gave C, 79·02, H, 10·22 per cent, $C_{20}H_{30}O_2$ requires C, 79 47, H, 9 93 per cent

The acid was stored as sodium tetra-abietate and was released as needed from the salt

The optical rotation of abietic acid in methyl, ethyl *n*-propyl, *iso*-propyl, *n*-butyl, sec-butyl, ter-butyl, amyl and *iso*-amyl alcohols was determined at 25°C and the results obtained are recorded in Tables I and II Pure, re-distilled solvents were employed.

Discussion

The specific rotation of abietic acid was found to obey Drude's simple dispersion formula, $[\alpha] = \frac{k}{\lambda^2 - \lambda_0^2}$ Straight line graphs are obtained when $\frac{1}{[\alpha]}$ is plotted against λ^2. The differences between the observed rotatory power (c) and the rotatory power (C) calculated from the dispersion equation is within the limits of experimental error. In general the deviation is ± 0·03°, but for Hg_{4358}, which is a difficult line to read, the deviation is ± 0·09°

The rotatory power of abietic acid in monohydric alcohols is found to decrease in the following order amyl alcohol > *iso*-butyl alcohol > sec-butyl alcohol > *n*-propyl alcohol > *iso*-amyl alcohol > ter-butyl alcohol > *n*-butyl alcohol > ethyl alcohol > *iso*-propyl alcohol > methyl alcohol. This sequence does not run strictly parallel to the dielectric constants of the solvents, namely methyl alcohol > *iso*-propyl alcohol > ethyl alcohol > *n*-propyl alcohol > ethyl alcohol > *n*-butyl alcohol > amyl alcohol > sec-butyl alcohol > ter-butyl alcohol > *iso*-amyl alcohol It is more logical to correlate the rotatory powers of a substance with the dielectric constants of the solutions and not with those of the solvents used The values for dielectric constants for solvents have been used in these experiments, as the values for abietic acid solutions were not available The rotatory power of abietic acid in various solvents was deduced from the rotatory power data for Hg_{5461}. This line was chosen at random. The same sequence was found to hold good with other wavelengths also

The absorption maxima values obtained from rotatory dispersion measurements are found to be in good agreement with the values obtained by measurements of absorption and by calculation using Woodward's method[4].

Du pont, Rouin and Dubourg[5] and George[6] have shown that the specific rotation of rosin acids depends not only on the solvent

TABLE I

(Temperature, 25°C)

Solvent conc. gm./100 c.c.	Methyl alcohol 2 4426			Ethyl alcohol 2 4430			n-propyl alcohol 2 4426			Iso-propyl alcohol 2 4426			n-butyl alcohol 2 4425		
Calculated	$[\alpha] - \frac{12\ 35}{\lambda^2-0\ 05899}$			$-\frac{12\ 64}{\lambda^2-0\ 05846}$			$-\frac{13\ 80}{\lambda^2-0\ 05856}$			$-\frac{12\ 49}{\lambda^2-0\ 05850}$			$-\frac{13\ 29}{\lambda^2-0{\cdot}05889}$		
λ_0	0 2429			0 2418			0 2419			0 2419			0 2425		
Line λ	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C
Hg	−94 30	−94 25	+0 05	−96 14	−96 06	+0 08	−106 69	−106 60	+0 09	−94 99	−94 95	+0 04	−101 47	−101 40	+0·07
Li	80 87	80 86	+0 01	82 44	82 46	−0 02	90 66	90 65	+0 01	81 48	81 46	+0 02	86 91	86 90	+0 01
Cd	77 20	77 23	−0 03	78 83	78 80	+0 03	86 64	86 62	+0 02	77 86	77 83	+0 03	83 13	83 10	+0 03
Cd	72 07	72 06	+0 01	73 53	73 52	+0 01	80 81	80 83	−0 02	72 64	72 65	−0 01	77 50	77 51	−0 01
Cd	61 84	61 83	+0 01	63 16	63 15	+0 01	69 39	69 40	−0 01	62 36	62 37	−0 01	66 51	66 52	−0 01
Cu	61 27	61 23	+0 04	62 51	62 50	+0 01	68 69	68 70	−0 01	61 75	61 74	+0 01	65 91	65 89	+0 02
Cu	59 75	59 77	−0 02	61 04	61 03	+0 01	67 07	67 08	−0 01	60 30	60 29	+0 01	64 30	64 31	−0 01
Cu	58 87	58 88	−0 01	59 08	59 10	−0 02	64 97	64 96	+0 01	58 35	58 37	−0 02	62 26	62 27	−0 01
Hg	51 62	51 63	−0 01	52 72	52 73	−0 01	57 97	57 95	+0 02	52 08	52 09	−0 01	55 55	55 56	−0 01
Cu	46 41	46 43	−0 02	47 44	47 42	+0 02	52 13	52 14	−0 01	46 86	46 85	+0 01	49 97	49 95	+0 02
Hg	44 91	44 90	+0 01	45 85	45 86	−0 01	50 46	50 42	+0 04	45 33	45·31	+0 02	48 33	48 32	+0 01
Na	42 87	42 84	+0 03	44 79	44 78	+0 01	48 12	48 11	+0 01	43 21	43 23	−0 02	46 12	46 10	+0 02
Li	39 28	39 29	−0 01	40 26	40 25	+0 01	44 25	44 24	+0 01	39 75	39 76	−0 01	42 36	42 39	−0 03
Cd	34 76	34 75	+0 01	35 52	35 51	+0 01	39 04	39 03	+0 01	35 06	35 07	−0 01	37 37	37 39	−0 02
Li	31 60	31 59	+0 01	32 29	32 28	+0 01	35 50	35 49	+0 01	31 88	31 89	−0 01	33 99	33 98	+0 01
	No mutarotation			No mutarotation			No mutarotation			No mutarotation			No mutarotation		

TABLE II

(Temperature, 25°C)

Solvent conc. gm./100 c.c.	Iso-butyl alcohol 2 4426			Sec butyl alcohol 2 4422			Ter-butyl alcohol 2 4424			Amyl alcohol 2 4426			Iso-amyl alcohol 2 4426		
Calculated	$[\alpha] - \frac{14\ 55}{\lambda^2-0\ 05910}$			$-\frac{14\ 22}{\lambda^2-0\ 05876}$			$-\frac{13\ 41}{\lambda^2-0\ 05899}$			$-\frac{18\ 49}{\lambda^2-0\ 05867}$			$-\frac{13\ 46}{\lambda^2-0\ 05860}$		
λ_0	0 2431			0 2424			0 2429			0 2422			0 2419		
Line λ	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C	Obs [α]	Cal [α]	Diff O-C
Hg	−111 12	−111 20	−0 08	−108 46	−108 40	+0 06	−102 32	−102 40	−0 08	−141 07	−141 00	+0 07	−102 60	−102 50	+0 10
Li	95 28	95 29	−0 01	92 92	92 90	+0 02	87 76	87 78	−0 02	120 92	120 90	+0 02	87 81	87 82	−0 01
Cd	91 06	91 05	+0 01	88 76	88 78	−0 02	83 87	83 86	+0 01	115 52	115 50	+0 02	83 94	83 91	+0 03
Cd	84 96	84 94	+0 02	82 86	82 84	+0 02	78 17	78 16	+0 01	107 83	107 80	+0 03	78 34	78 32	+0 02
Cd	72 90	72 88	+0 02	71 10	71 09	+0 01	67 14	67 13	+0 01	92 49	92 50	−0 01	67 22	67 25	−0 03
Cu	72 19	72 16	+0 03	70 41	70 40	+0 01	66 45	66 42	+0 03	91 62	91 60	+0 02	66 56	66 58	−0 02
Cu	70 42	70 43	−0 01	68 70	68 72	−0·02	64 82	64 83	−0 01	89 40	89 43	−0 03	65 01	65·00	+0 01
Cu	68 18	68 20	−0 02	66 56	66 55	+0 01	62 85	62 83	+0 02	86 69	86 70	−0 01	62 91	62 90	+0 01
Hg	60 85	60 84	+0 01	56 36	56 37	−0 01	56 07	56 05	+0 02	77 22	77 26	−0 04	56 19	56 20	−0 01
Cu	54 69	54 71	−0 02	53 41	53 40	+0 01	50 40	50 41	−0·01	69 43	69 45	−0 02	50 50	50 51	−0 01
Hg	52 91	52 90	+0 01	51 67	51 64	+0 03	48 76	48 75	+0 01	67 16	67 18	−0 02	48 84	48 86	−0·02
Na	50 49	50 48	+0 01	49 26	49 26	+0 00	46 53	46 50	+0 03	64 11	64 10	+0 01	46 59	46 61	−0 02
Li	46 40	46 41	−0 01	45 34	45 30	+0 04	42 80	42 77	+0 03	56 96	56 94	+0 02	42 89	42 87	+0 02
Cd	40 92	40 94	−0 02	39 96	39 95	+0 01	37 34	37 33	+0 01	51 93	51 97	−0 04	37 86	37 82	+0 04
Li	37 20	37 22	−0 02	36 35	36 33	+0 02	34 30	34 29	+0 01	47 30	47 27	+0 03	34 41	34 39	+0 02
	No mutarotation			No mutarotation			No mutarotation			No mutarotation			No mutarotation		

employed, but also on their concentration in the solvent Systematic work undertaken in this laboratory shows that in methyl, ethyl and *iso*-amyl alcohols, there is an increase in specific rotation of abietic acid as the concentration in the solvent increases With *iso*-propyl, *n*-propyl, *iso*-butyl, *n*-butyl, amyl, sec-butyl, ter-butyl alcohols, the specific rotation increases with concentration of abietic acid up to a certain point beyond which it begins to decrease

The values obtained for the optical rotation of abietic acid in monohydric alcohols can be easily explained on the basis of association and compound formation of organic acids in solvents.

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Vaccenic Acid & Its Relation to the Alleged Grass-juice Factor

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Feeding experiments on rats show that vaccenic acid has no growth-promoting properties A butter diet increased the vaccenic acid content of the body fat of the rat, but the increase is unaccompanied by any change in the growth rates Neither butter nor paddy grass contain any unidentified factors necessary for rat nutrition.

THE superior growth-promoting property of butter has been the subject of many investigations[1-15] Schantz *et al*[14] claimed that prematurely weaned rats did not grow well owing to the lack of an essential factor present in butter, and that this growth retardation disappeared after six weeks if the animals were fed on a stock diet When weanling rats were treated to a lactose-rich diet, Boutwell *et al*[16] found that those receiving butter fat grew better than those receiving vegetable or hydrogenated fats This superiority was no longer recorded when a mixed carbohydrate diet was given The reported superiority of butter fat, if lactose was present in the concentration found in skimmed milk[14], has not been confirmed by others[2,8] It has been suggested that the better growth observed with butter fat might be explained on the basis of food preference for the butter flavour, whereby the animals consumed more and grew more rapidly[8]

Deuel and his associates[3,4] were unable to confirm the presence of any unidentified nutrient in butter Their results are supported by those of Zialcita and Mitchell[15], and those of Euler *et al*[5,6] The experiments of Jack *et al*[9] as well as those of Henry, Kon, Hilditch and Meara[8] indicated that there was no one fraction of butter the growth-promoting action of which was superior to that of whole butter But Geyer *et al*[7] and Nath *et al*[12] have recently reported the superior growth-promoting action of a liquid fraction of butter remaining after separation of the solid portion from an acetone solution at −4°C

Boer and Jansen[17,19] found that "summer" butter, obtained from the milk of cows fed on green grass, contained a growth-promoting factor, other than vitamin A, and the other known fat-soluble vitamins. They reported[18] that it was the vaccenic acid fraction of summer butter that was responsible for the increased growth Addition of vaccenic acid to a rape seed oil diet was found to promote growth as much as summer butter did

A significant factor in connection with the disputed growth-promoting action of "summer" butter, as compared to "winter" butter, is the reported occurrence of an unidentified nutrient in grasses[20-23] The work of Kohler *et al*[22] indicates that grasses contain a grass-juice factor and that young rats maintained on the milk of cows fed on green grass grew at the rate of 4 gm a day whereas rats maintained on mineralized winter milk (i e milk yielded by cows on a non-grass winter regimen plus the necessary mineral salts) grew at the rate of only 2 5 gm per day The work of Cary and Hartman[20] also indicates that besides certain other substances like milk and liver, alfalfa hays, timothy hays and Kentucky blue grass contain an unidentified nutrient or nutrients

The announcement by Boer *et al* (loc cit) that vaccenic acid was the growth promoting factor present in "summer" butter, coupled with the report of the presence of still another unidentified factor in fresh grasses leads one to the plausible supposition that a grass diet enables the cow to elaborate an unidentified "summer" butter factor which may be identical with vaccenic acid Feeding green grass might, therefore, result in an increase of the vaccenic acid content of either the body fat alone or both milk fat and body fat This hypothesis supports the claim of Brouwer and Sjoncker-Schaffner[24] that the milk of cows fed on grass contains higher amounts of vaccenic acid

In the present investigation experiments were carried out to enquire into the presence of still unidentified nutrients in paddy grass and in summer butter, and the possible conversion of the one to the other in the rat The vaccenic acid content of the body fat of the rats was also determined in order to correlate any higher growth rates with higher contents of vaccenic acid

Experimental

Young weanling rats (28-30 days old) were divided into 3 groups, each group consisting of 3 males and 3 females Care was taken to effect equal distribution of litter mates The diet of these rats was made up as shown below

Constituent	*% by weight of diet*
Rice powder*	35
Wheat powder*	35
Casein* (B D H light white)	10
Dried yeast*	6
Salt mixture†	4
Fat	10

Vitamins A and D were added as the unsaponifiable part of a shark liver oil concentrate dissolved in coconut oil along with vitamin E For groups I and II the fat given was coconut oil (purified to solidify at 20°-26°C) and the rats in group III were fed on butter In addition the rats in group II received fresh paddy grass (finely ground up) to the extent of 10 per cent of the whole diet The rats were fed *ad libitum* and care was taken to supply more food to each rat than it actually consumed The cages were placed in such a manner that coprophagy was eliminated to a considerable extent

Besides these 3 groups, 4 female rats from the same litters were maintained on our stock diet, which was composed as shown below

Constituent	*Parts by weight*
Paddy rice and wheat finely ground	60
Groundnut cake	10
Pulses	5
Skim-milk powder	10
Salt mixture	1
Arachis oil	1
Dried fish	3
Fresh radish leaves	5
Germinated pulses	5

with additional supply of fresh milk (10 c c per rat per day) The growth of these rats was measured by weighing them every week

After feeding for 40 days on the experimental diets, the rats were killed in the morning and were dissected to see that no food was present in the intestinal tract The caracasses were minced and dried with plaster of Paris The dried product was ground and each group was divided into 3 batches for purposes of analysis Each batch was extracted thoroughly by

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* Freed from fat by extraction with light petroleum

† Phillips and Hart salt mixture[25]

TABLE I — VACCENIC ACID CONTENT OF SOME COMMON SOUTH INDIAN FATS

Fat	Vaccenic acid %
Coconut oil	0 88
Arachis oil	1 14
Butter (pooled sample)	2 36
Pig back fat	0 96
Beef back fat	1 53

TABLE II — INCREASE IN THE WEIGHTS OF RATS (GM)

No of weeks	Group I Control — coconut oil alone		Group II coconut oil & paddy grass		Group III butter	
	Males	Females	Males	Females	Males	Females
1	18 9	15 9	18 9	19 7	15 4	8 5
2	37 4	38 7	43 0	36 3	41 9	30 0
3	79 7	59 6	70 3	61 6	70 7	49 8
4	101 4	75 5	95 2	73 8	93 5	63 2
5	114 6	83 7	112 9	85 2	118 2	75 2

refluxing repeatedly with petroleum ether (b p 40° 60°C) The fat was prepared from the extracts by distilling off the petroleum ether on a water bath The fat was saponified and the fat acids were liberated from the soaps The fat acids were washed with lukewarm water and weighed The iodine value of the fat acids was determined according to A O A C methods (Hanus method) The content of vaccenic acid in the fat acids of the body fat of rats was determined according to the method of Cocks, Christian and Harding[26]

TABLE III — ANALYSIS OF THE BODY FAT OF RATS

	Group I			Group II			Group III			Stock	
	1	2	3	1	2	2	1	2	3	1	2
Sex	M & M	M & F	F & F	M & M	M & F	F & F	M & M	M & F	F & F	F & F	F & F
Carcass weight gm	317 00	302 50	290 00	321 00	373 00	271 20	338	277 00	254 00	273 00	308 00
Fat in carcass %	16 10	17 00	14 80	16 00	15 30	14 70	Lost	15 30	14 20	10 50	11 20
Iodine value of fat acids	32 27	35 34	38 64	37 15	35 32	33 50		42 84	41 62	23 80	26 50
Vaccenic acid in fat acids %	1 46	1 36	1 53	1 50	1 40	1 38		2 10	1 99	0 96	1 21

Vaccenic acid content of some common South Indian fats are given in Table I while the weekly increases in the growth of the rats placed on the different diets are given in Table II and the vaccenic acid contents of the body fat of rats are given in Table III The data show no significant differences in the growth of male or female rats over a 5-week period, when the diet contained butter fat or coconut oil Addition of fresh paddy grass to the diet of rats did not result in any increased rate of growth Paddy grass, which is similar to barley, wheat and oat grasses, used by Kohler *et al* (loc cit), did not contain any unidentified growth-promoting factor necessary for the white rat Also feeding fresh paddy grass has not been found to increase the vaccenic acid content of the body fat of the white rat Perhaps the elaboration of vaccenic acid from a grass diet is carried out by the cow and not the rat, and the rumen is probably the site of its formation The ability of the cow to do so seems to be indicated by the fact that beef fat contains higher amounts of vaccenic acid than pig fat

A butter diet increased the vaccenic acid content of the body fat of the rat This is due to the higher content of vaccenic acid in butter than in coconut oil However, the higher vaccenic acid content of the body fat of rats fed on butter was not accompanied by increased growth rates This demonstrates that vaccenic acid has no growth-promoting properties, a conclusion which is in conformity with other observations[11 13 27]

Summary

1 From our feeding experiments, it is concluded that neither butter nor paddy grass contain any unidentified nutrients necessary for the rat

2 The white rat cannot elaborate vaccenic acid from a diet containing 10 per cent of paddy grass

3 Vaccenic acid has no growth-promoting properties

The authors wish to thank the Lady Tata Memorial Trust for the award of a scholarship to one of us (D V S S)

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Supplementary Value of Groundnut Cake to Tapioca & Sweet Potato

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Addition of groundnut cake flour to diets largely composed of tapioca or sweet potato flour promotes good growth in young rats whereas the rats fed on tapioca or sweet potato flour containing pulses and vegetables lost body weight Animals fed on a poor rice diet in which 25 per cent of rice has been replaced by a mixture of 4 parts of tapioca or sweet potato flour and 1 part of groundnut cake flour also grew well, showing thereby that the nutritive value of poor rice diet was improved by replacing some rice by the above mixtures

IN Travancore and certain other parts of India tapioca is used as a staple food More recently the use of sweet potato has also been advocated and attempts are being made to popularize its use With a view to meeting the present shortage in the supply of cereals the Subsidiary Food Production Committee of the Government of India recommended (1) the extensive cultivation and use of tapioca and sweet potato as these tubers give comparatively higher yields (3 to 4 times) of calories per acre than the commoner cereals and (2) the utilization of specially prepared groundnut cake flour as human food

Using the rat growth method Aykroyd and Krishnan[1] showed that poor diets based on tapioca are deficient in proteins as compared with the poor rice diet They also investigated the possibility of improving the poor tapioca diet with various supplements like skimmed milk powder casein and different pulses Their investigations showed that casein and skimmed milk powder proved effective supplements by markedly increasing the growth rate while the different pulses were comparatively ineffective Presumably the relatively low biological value of pulse proteins[2] partially accounts for the failure of these foods to act as effective supplements

Since foods of animal origin which are rich in proteins of high biological value are costly and not within the reach of the poor people there is a need to search for cheap and effective protein supplements to tapioca diet

Groundnut cake flour is a rich source of proteins and certain vitamins of the B-

TABLE I — THE CHEMICAL COMPOSITION OF FOODSTUFF USED IN THE EXPERIMENT

(Values per 100 gm. of food)

FOODSTUFF	MOISTURE, gm.	PROTEIN, gm.	FAT, gm.	FIBRE, gm	ASH, gm.	CARBOHYDRATE BY DIFFERENCE, gm	CALORIFIC VALUE	CALCIUM, gm.	PHOSPHORUS, gm.	IRON mg	VIT B, mg.	NICOTINIC ACID, mg	RIBOFLAVIN, mg
Tapioca flour	9 0	1 7	0 5	1 9	1 4	65 5	353	0 06	0 08	33 0*	0 12	1 8	0 03
Sweet potato flour	8 3	1 7	0 9	2 5	3 8	82 8	346	0 11	0 13	28 7*	0 15	2 8	0 05
Groundnut cake flour (without outer red cuticle)	11 0	52 7	8 9	1 0	4 6	21 8	378	0 07	0 50	2 9	0 95	19 5	0 20
Raw milled rice	13 0	6 9	0 4		0 5	79 2	348	0 01	0 11	2 2	0 10	1 2	0 02
Whole wheat flour	12 8	12 0	1 5	2 0	1 5	70 2	342	0 05	0 32	5 3	0 45	4 5	0 15
Mixture of 4 parts of tapioca flour and 1 part of groundnut cake flour'	9 4	11 9	2 2	1 7	2 0	72 8	359	0 06	0 16	27 0	0 30	5 3	0 06
Mixture of 4 parts of sweet potato flour plus 1 part of groundnut cake flour	8 8	11 9	2 5	2 2	3 9	70 7	353	0 10	0 20	23 0	0 31	6 1	0 08

* Due to contamination during powdering the dried chips in mills.

complex (TABLE I) Consumer trials carried out recently in our laboratory showed that it could be consumed by adults without any adverse effect up to at least 1 ounce per day. It appeared to us that it would be worth while to investigate whether groundnut cake flour has any supplementary value to tapioca and sweet potato The investigations reported in this paper have shown that groundnut cake flour has a remarkable supplementing value to poor diets based on tapioca and sweet potato flour and a mixture of 4 parts of tapioca or sweet potato flour and 1 part of groundnut cake flour has a nutritive value which is much superior to that of rice

Experimental

The chemical composition of tapioca, sweet potato and groundnut cake flour as also certain mixtures prepared out of them, as compared with rice and wheat, are given in Table I It will be seen that the main deficiency of the tuber flours is in regard to the protein This is largely made up by admixture with groundnut cake flour

The experimental diets used in the present study are given in Table II The rat growth method employed by other workers[1,3] was adopted in these studies

Seven groups of young albino rats (8 in each group), about 4 weeks' old and weighing 45 to 50 gm , were fed the above diets To make the feeding uniform, the cereals and pulses were powdered and mixed with the diet The mixed diet was cooked with one and half times its weight of water to a pasty mass and fed *ad libitum* to the rats The average weekly increase in body weights of the different groups of animals is given in Table III , the rate of growth of rats on the different diets is shown in Fig 1

Discussion

The results confirm the earlier findings of Aykroyd and Krishnan (loc cit) that a poor diet based mainly on tapioca does not support life The response to sweet potato is also of the same order The addition of groundnut cake flour to the tapioca or sweet potato diet produced, however, a remarkable improvement in the nutritive value of the diet, making it much superior to the poor rice diet This observation is of further interest as Kuppuswamy *et al*[4] showed that addition of groundnut

TABLE II — THE COMPOSITION OF THE EXPERIMENTAL DIETS

NAME OF FOODSTUFFS	DIET I %	DIET II %	DIET III %	DIET IV %	DIET V %	DIET VI %	DIET VII %
Tapioca flour	78 5		62 8			15 7	
Sweet potato flour		78 5		62 8			15 7
Groundnut cakeflour			15 7	15 7		3 9	3 9
Raw milled rice					78 5	58 9	58 9
Red gram (Tur dhal)	5 0	5 0	5 0	5 0	5 0	5 0	5 0
Non leafy vegetables (brinjal, potato and raw plantain)	8 2	8 2	8 2	8 2	8 2	8 2	8 2
Leafy vegetables (amaranth, cabbage etc)	2 1	2 1	2 1	2 1	2 1	2 1	2 1
Crude groundnut oil	5 0	5 0	5 0	5 0	5 0	5 0	5 0
Milk powder	0 9	0 9	0 9	0 9	0 9	0 9	0 9
Common salt	0 3	0 3	0 3	0 3	0 3	0 3	0 3

cake flour at a 10 per cent level to poor rice diet had practically no supplementary value

It is interesting to note that even in the poor rice diet, replacement of 25 per cent of rice by a mixture of (1) tapioca (80 parts) and groundnut cake (20 parts) or (2) sweet potato (80 parts) and groundnut cake (20 parts) produces striking growth response, thus showing that the supplementary effect of the mixture of the tuber and the cake is to be seen at even comparatively low levels of intake The available evidence is not, however, sufficient to show whether the supplementation is essentially one of protein or the overall effect including that of minerals and vitamins

Arising from their earlier investigations, Aykroyd and Krishnan had sounded a note of warning against the extended cultivation and use of tapioca as a staple food unless the diet could be supplemented by proteins of high biological value such as those from milk, fish, meat and egg Such supplements being beyond the means of a large section of the population, the striking effect produced by a cheap material like groundnut cake would come as a welcome relief It is possible that, besides groundnut cake, there are also quite a number of other food materials, equally cheap and abundant, which could adequately supplement the poor diets based mainly on tubers Further work in this direction is in progress

TABLE III — AVERAGE WEEKLY INCREASE IN BODY WEIGHT OF YOUNG RATS ON DIFFERENT DIETS (DURING 8 WEEKS)

DIET No	CHIEF INGREDIENT IN THE DIET	AVERAGE WEEKLY INCREASE IN BODY WEIGHT, GM
1	Tapioca flour	The animals lost weight at an average of 0 5 gm per week (3 died in 8 weeks)
2	Sweet potato flour	The animals lost weight at an average of 0 8 gm per week (3 died in 8 weeks)
3	Tapioca plus groundnut cake flour (4 1)	10 3 ± 0 45
4	Sweet potato plus ground nut cake flour (4 1)	8 6 ± 0 58
5	Raw milled rice	3 9 ± 0 2
6	Raw milled rice plus tapioca plus groundnut cake flour	9 2 ± 0 37
7	Raw milled rice plus sweet potato flour plus ground nut cake flour	9 4 ± 0 54

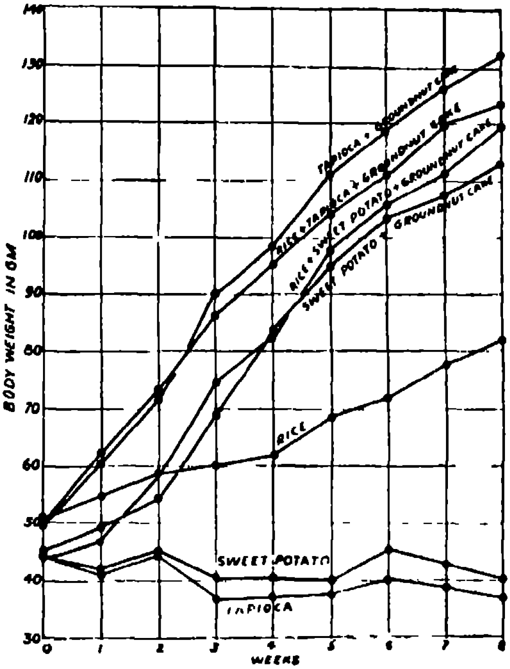

FIG 1 — INCREASE IN BODY WEIGHT OF RATS ON DIFFERENT DIETS

Summary

1 Young rats fed on a diet largely composed of tapioca or sweet potato flour and containing, in addition, pulses, vegetables, etc , in amounts corresponding to the usual consumption of poor rice-eaters in South

India, lost body weight Some of the animals died within 8 weeks

2. Addition of groundnut cake flour to the above diet proved an effective supplement, promoting good growth, the average weekly increase in body weight being 10 3 gm and 8 6 gm respectively, as against 3 9 gm obtained with poor rice diet

3 Animals fed on a poor rice diet in which 25 per cent of rice have been replaced by a mixture of 4 parts of tapioca or sweet potato flour and 1 part of groundnut cake flour also grew well, showing thereby that the nutritive value of poor rice diet was improved by replacing some of the rice by the above mixture.

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Investigation on the Chemical Composition of Triplite

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The formula (Fe, Mn)$_2$PO$_4$ F has been assigned to the mineral triplite on the basis of quantitative chemical analysis.

TRIPLITE occurs in quartz veins of granites accompanied by apatite at Limoges in France It is also found in masses in quartz with beryl, apatite, columbite at Sierra de Cordoba, Argentina The Indian mineral under investigation was collected from a mica mine, 2 miles south-east of Singar, Gaya district, Bihar The mineral was deep brown in colour with a resinous lustre, its streak was brown, hardness, 4-5 and specific gravity, 3·7

Experimental

The mineral was crushed to small pieces and a selected portion was powdered to pass through 200 mesh The analytical procedure is given in the following scheme

For the estimation of ferrous iron, some of the crushed fragments of the mineral were decomposed by heating with hydrochloric and hydrofluoric acid in an atmosphere of CO_2, cooled, boric acid added and the solution titrated with standard $K_2Cr_2O_7$ solution using diphenylamine sulphonate as internal indicator

The mean values from a duplicate analysis are given below,

ANALYSIS OF TRIPLITE FROM GAYA

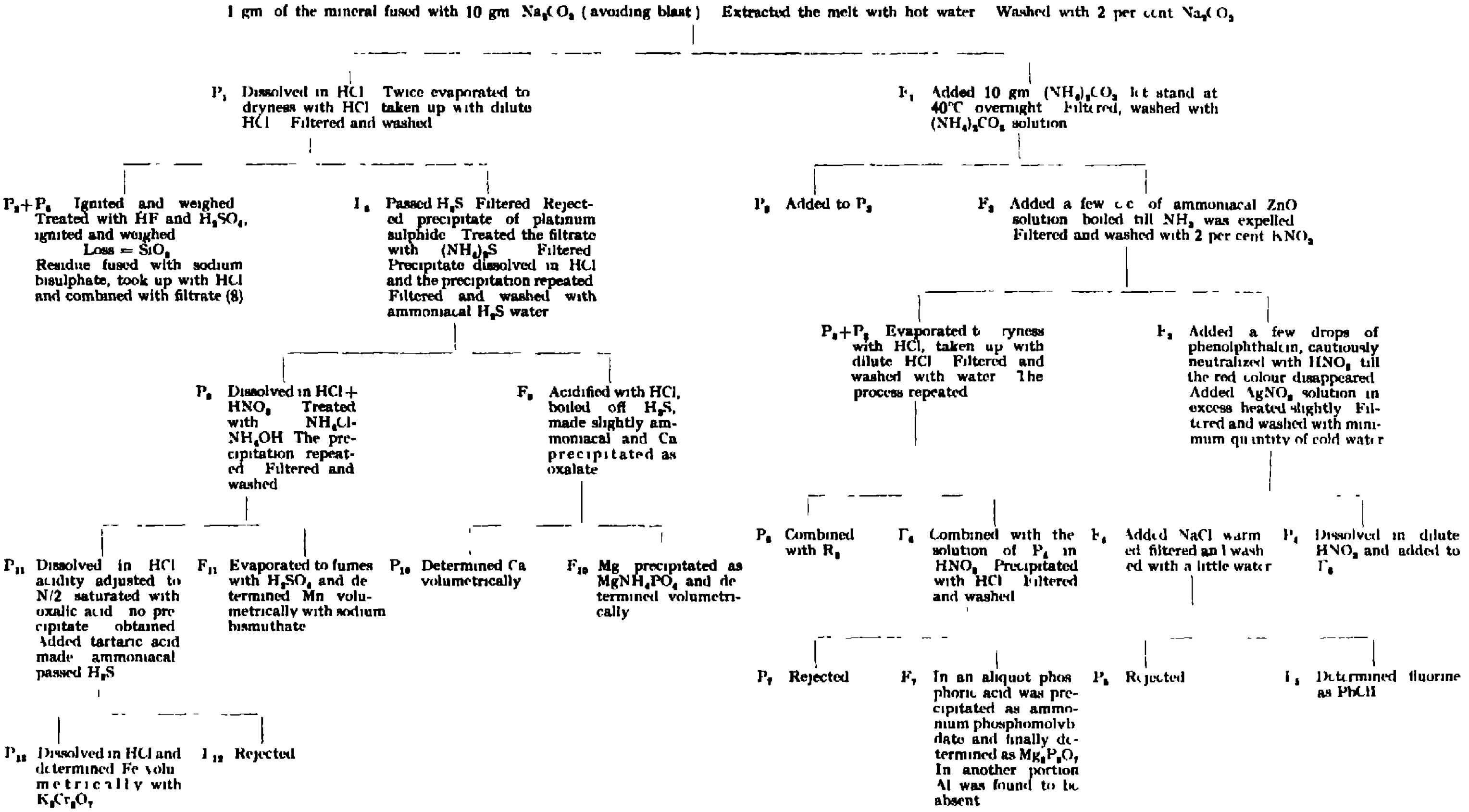
		PER CENT
P_2O_5		30 60
FeO		29 20
Fe_2O_3		2 30
MnO		28 55
SiO_2		1 05
CaO		1 75
MgO		1 85
F		8 00
Th+R E		0 00
		103 30
	O ≡ F	3 40
	Total	99 90

Chemical Formula

Rammelsberg calculated the formula of triplite as $R_2P_2O_8RF_2$ or $(RF)RPO_4$, where R represents Fe, Mn, also Ca and Mg. The ratio Fe Mn varies widely in different samples of the mineral from different localities, viz Fe : Mn = 1 1, 2 1, 1 2 and even 1 7 On calculation from the analytical data obtained by us we arrived at the formula (Fe, Mn)$_2$PO$_4$ F, where the ratio of Fe (Ca) Mn (Mg) = 1 . 1.

Our thanks are due to Prof P B. Sarkar for his keen interest in the work and to the Council of Scientific & Industrial Research for financial help. We are also thankful to the Director, Geological Survey of India, for supplying the mineral.

AN OUTLINE OF THE SCHEME OF ANALYSIS



1 gm of the mineral fused with 10 gm Na_2CO_3 (avoiding blast) Extracted the melt with hot water Washed with 2 per cent Na_2CO_3

P_1 Dissolved in HCl Twice evaporated to dryness with HCl taken up with dilute HCl Filtered and washed

P_8+P_5 Ignited and weighed Treated with HF and H_2SO_4, ignited and weighed
Loss = SiO_2
Residue fused with sodium bisulphate, took up with HCl and combined with filtrate (8)

F_8 Passed H_2S Filtered Rejected precipitate of platinum sulphide Treated the filtrate with $(NH_4)_2S$ Filtered Precipitate dissolved in HCl and the precipitation repeated Filtered and washed with ammoniacal H_2S water

P_9 Dissolved in HCl + HNO_3 Treated with NH_4Cl-NH_4OH The precipitation repeated Filtered and washed

F_9 Acidified with HCl, boiled off H_2S, made slightly ammoniacal and Ca precipitated as oxalate

P_{11} Dissolved in HCl acidity adjusted to N/2 saturated with oxalic acid no precipitate obtained Added tartaric acid made ammoniacal passed H_2S

F_{11} Evaporated to fumes with H_2SO_4 and determined Mn volumetrically with sodium bismuthate

P_{10} Determined Ca volumetrically

F_{10} Mg precipitated as $MgNH_4PO_4$ and determined volumetrically

P_{12} Dissolved in HCl and determined Fe volumetrically with $K_2Cr_2O_7$

F_{12} Rejected

F_1 Added 10 gm $(NH_4)_2CO_3$ let stand at 40°C overnight Filtered, washed with $(NH_4)_2CO_3$ solution

P_2 Added to P_3

F_2 Added a few c c of ammoniacal ZnO solution boiled till NH_3 was expelled Filtered and washed with 2 per cent KNO_3

P_3+P_2 Evaporated to dryness with HCl, taken up with dilute HCl Filtered and washed with water The process repeated

F_3 Added a few drops of phenolphthalein, cautiously neutralized with HNO_3 till the red colour disappeared Added $AgNO_3$ solution in excess heated slightly Filtered and washed with minimum quantity of cold water

P_5 Combined with R_8

F_5 Combined with the solution of P_4 in HNO_3 Precipitated with HCl Filtered and washed

F_4 Added NaCl warmed filtered and washed with a little water

P_4 Dissolved in dilute HNO_3 and added to F_5

P_7 Rejected

F_7 In an aliquot phosphoric acid was precipitated as ammonium phosphomolybdate and finally determined as $Mg_2P_2O_7$ In another portion Al was found to be absent

P_6 Rejected

F_6 Determined fluorine as PbClF

Study of Mullite Crystals in Porcelain Bodies

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Calcutta

The formation of mullite crystals in a porcelain body fabricated by different methods has been investigated. Slow firing and cooling favour the formation of mullite in larger crystals. Articles prepared by pressing and casting contain more mullite than those obtained by extrusion

MANY properties of porcelain have been attributed to the presence of mullite crystals formed in the porcelain body during firing Porcelain bodies containing mullite show good mechanical strength and refractory properties, possess a low and uniform rate of thermal expansion, and withstand high stresses at elevated temperatures and voltages.

Mullite is always present in a porcelain body in varying quantities, either in a crystalline or other form It is an aluminium silicate ($3Al_2O_3 2SiO_2$) containing 71 8 per cent alumin a and 28 2 per cent silica by weight

The formation of mullite crystals in the ceramic body, both in size and quantity, is dependent on (1) the nature of raw materials, (2) body composition, (3) particle size of the ingredients, (4) homogeneity and compactness of the mixture and (5) the thermal treatment during manufacture Oxides of chromium, boron, copper, manganese, magnesium, calcium and iron, and talc are known to catalyse the formation of mullite[1-4] Hydro-thermal synthesis also helps in the formation of mullite[5]

The present investigation was undertaken to investigate the following aspects of mullite formation (1) quantity of mullite formed in porcelain bodies by casting, dry-pressing and extrusion, (2) effect of different temperatures, (3) growth and distribution of mullite, (4) effect of firing period, (5) influence of cooling period and (6) mullite formation in specimens of varying thicknesses.

Experimental

The test articles were fabricated by casting, extrusion and dry-pressing from the same mix The body was prepared from a mixture of kaolin, feldspar and quartz in the proportion of 50 25 25, by weight The raw materials (which were obtained from Czechoslovakia) had the following chemical composition (TABLE 1)

TABLE I

	KAOLIN* %	FELDSPAR † %	QUARTZ ‡ %
SiO_2	46 50	65 15	99 80
Al_2O_3	39 00	16 91	
Fe_2O_3	0 50	0 145	0 02
CaO	0 60	1 765	
TiO_2	0 15		
MgO		0 235	
K_2O	0 80	11 92	
Na_2O	0 30	2 31	
Loss on ignition	13 00		

*Sodlic † Krupka ‡ Jilove (Czechoslovakia)

The following is the Seger formula for the body composition

RO R_2O_3 RO_2 is

Na_2O — 0·0039
K_2O — 0·1885 Al_2O_3 — 0 9925 SiO_2 — 4 4780
CaO — 0 0551 Fe_2O_3 — 0·0075 TiO_2 — 0 0038
MgO — 0·0063

Feldspar and quartz were first washed clean and calcined in an electric furnace at 800°C Requisite quantities of feldspar and quartz needed for the body mix of 2 kg were ground in a pot-mill for 25 hr, the required amount of kaolin added, and ground for another 2 hr The slurry obtained was passed through a ferro-filter, then through a 900 mesh/sq cm sieve and finally filtered on a Buchner funnel A portion of the material was dried in an air oven at 105°C and used for dry-pressing, another portion was partially dried (*c* 25 per cent moisture) for extrusion, from the remainder a casting slip was prepared

Articles of different thicknesses (10 mm and 1 9 mm) were prepared The samples were first dried in air for 24 hr and then in an air oven at 90°C for another 24 hr before firing The different test samples were fired together in the same furnace during each firing

The firing schedules employed are given in Table II

TABLE II

	BURNING	COOLING
a	Gas fired muffle up to 1 400°C in 24 hr	Cooled down to 1 200 C in the same furnace in 7 5 hr and then quenched in cold water
b	do	Cooled to 825°C as above in 15 5 hr then in the same furnace to room temperature in 22 hr
c	do	Cooled to 825°C in 16 5 hr then annealed in an electric kiln and cooled down to room temperature in 34 hr
d	Burnt in an electric muffle up to 1 300°C in 8 hr	Cooled in the same kiln in 16 hr without any control
e	Burnt in the gas fired muffle up to 1 400°C in 86 hr	Cooled in the same furnace in 26 hr without any control
	do	Cooled in the same furnace to 880 C in 24 hr then in gas fired furnace to room temperature in about 81 hr
g	Burnt in an electric furnace up to 1 580°C in 8 hr	Cooled in about 15 hr without any control
h	Burnt in the gas fired muffle up to 1 400 C in 10 5 hr	Cooled in the same furnace for 26 hr without any control

Firings (a), (b) and (c) were carried out in one operation and during cooling, samples were taken out at 1 200°C and 825°C for further cooling as in firings (a) and (c) respectively Firings (e) and (f) were made separately Firing schedules (d) (g) were carried out in an electric resistance kiln In the gas-fired furnace, the firing (h) was first carried out in an oxidizing atmosphere up to 900°C then in a reducing atmosphere up to 1,200°C and finally in a slightly reducing atmosphere up to 1,400°C Only oxidizing atmosphere was employed in the electric kiln

The test samples prepared according to the different processes and firing schedules are given in Table III

Testing — The mullite formed in the samples (excepting 20, 21) was quantitatively estimated by the hydrofluoric acid method[1] Thin sections of the samples were examined under the microscope and the growth and distribution characteristics of

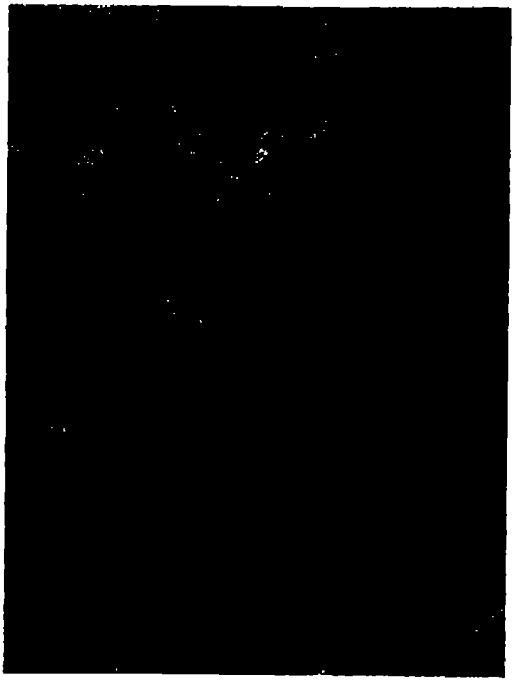

FIG 1 — PHOTOMICROGRAPH OF SAMPLE No 8

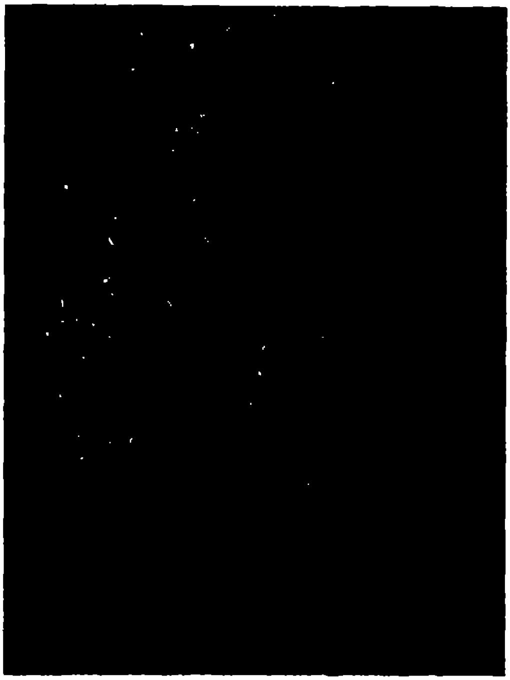

FIG 2 — PHOTOMICROGRAPH OF SAMPLE No 14

FIG 3 — PHOTOMICROGRAPH OF SAMPLE No 15

the mullite crystals noted The crystals could be identified only under high magnification through an oil immersion lense The amounts of mullite found in the samples are given in Table III

Photomicrographs (X 820) of a few test specimens are reproduced in Figs 1-11

Discussion

Slow cooling of fired articles to room temperature gives a maximum yield of mullite whereas slow cooling up to 825°C only gives a lower value (TABLE III) The data relating to samples 3 and 6 reveal that slower firing and cooling than that of schedule (c) does not enhance the mullite content on the contrary the values are lower thereby demonstrating that a slower firing schedule than 24 hr and a cooling schedule of 50 hr are not necessary for ensuring optimum mullite formation Sample 5 gave a much lower yield of mullite than sample 6 thereby emphasizing the need for slow cooling The data for samples 4 7 and 8 indicate that low firing temperatures produce little mullite they also show

TABLE III — AMOUNT OF MULLITE IN DIFFERENT SAMPLES

SR No	DESCRIPTION OF SAMPLES	WT OF SAMPLE TAKEN gm	WT OF MULLITE FOUND gm	CORRECTED WT OF MULLITE gm	PERCENTAGE OF MULLITE IN THE MASS
1	This was a portion of thin crucible made by casting and fired according to the firing (a)	0 4158	0 0818	0 0986	23 71
2	Same as above but fired as per (b)	0 4037	0 0838	0 1010	25 02
3	Same as above but fired as per ( )	0 3907	0 0821	0 0990	[illegible] 33
4	Same as above but fired as per (d)	0 4177	0 0360	0 0434	10 39
5	Same as above but fired as per (e)	0 4023	0 0727	0 0876	21 77
6	Same as above but fired as per (f)	0 4033	0 0837	0 1009	25 02
7	This was made by dry pressing and fired as per (g) the sample was partially melted and became porous	0 4037	0 0625	0 0786	19 47
8	Same as above but fired as per (h) and was not melted	0 4033	0 0754	0 0909	22 53
9	This was made by extrusion and fired as per (c)	0 3957	0 0810	0 0996	24 66
10	Same as above but fired as per (d)	0 4004	0 0195	0 0235	5 86
11	Same as above but fired as per (e)	0 4030	0 0705	0 0849	21 06
12	Same as above but fired as per (f)	0 4033	0 0827	0 0997	24 72
13	This was made by pressing and fired as per (c)	0 4020	0 0831	0 1001	24 90
14	Same as above but fired as per (d)	0 4036	0 0219	0 0257	6 36
15	Same as above but fired as per (e)	0 4010	0 0745	0 0898	22 39
16	Same as above but fired as per (f)	0 4040	0 084[illegible]	0 1015	25 12
17	This was made by casting and of about 5 times the thickness of the thin crucible and fired as per (c)	0 4046	0 0843	0 1016	25 11
18	Same as above but fired as per (e)	0 4034	0 0726	0 0875	21 69
19	Same as above but fired as per (f)	0 4046	0 0826	0 0995	24 95
20	Same as No 14 of this table but fired as per (a)				
21	Same as above but fired as per (b)				

FIG 4 PHOTOMICROGRAPH OF SAMPLE No 6

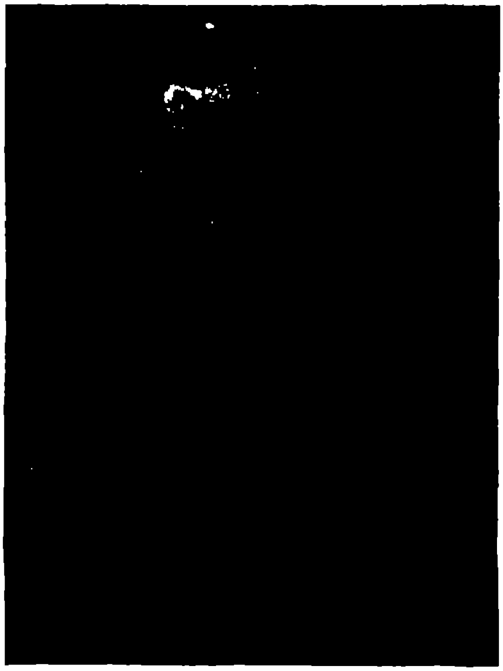

FIG 6 PHOTOMICROGRAPH OF SAMPLE No 13

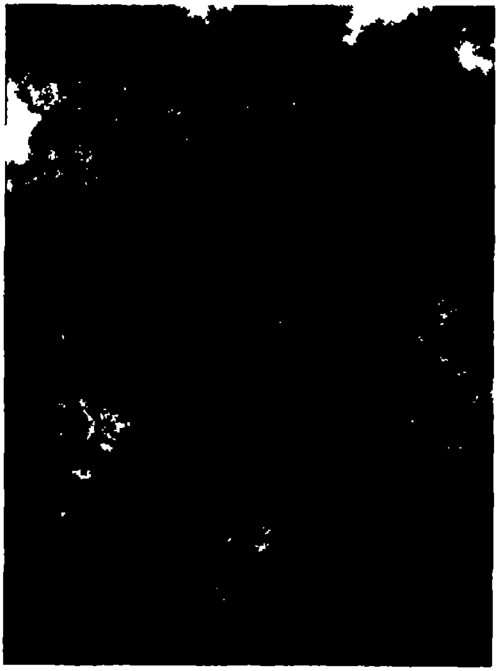

FIG 5 PHOTOMICROGRAPH OF SAMPLE No 12

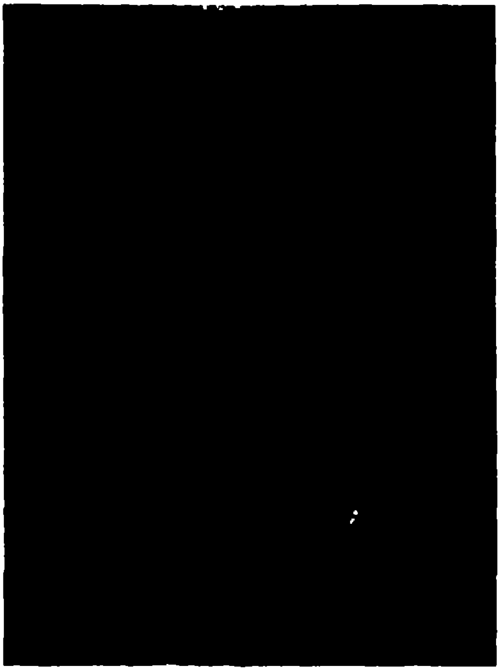

FIG 7 PHOTOMICROGRAPH OF SAMPLE No 16

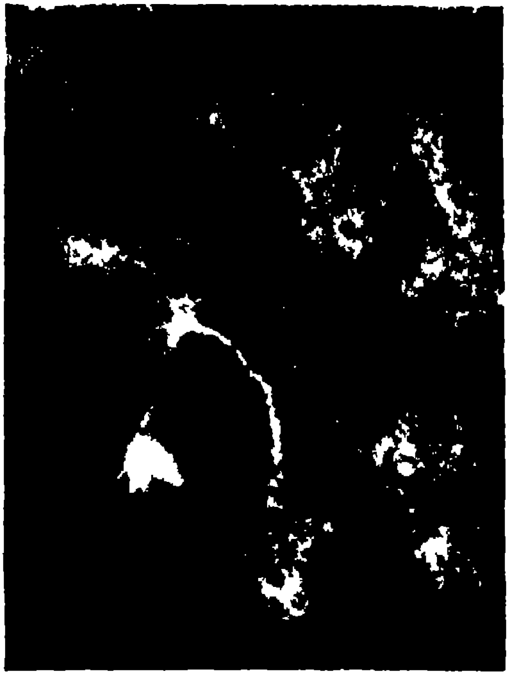

Fig 8 — Photomicrograph of sample No 19

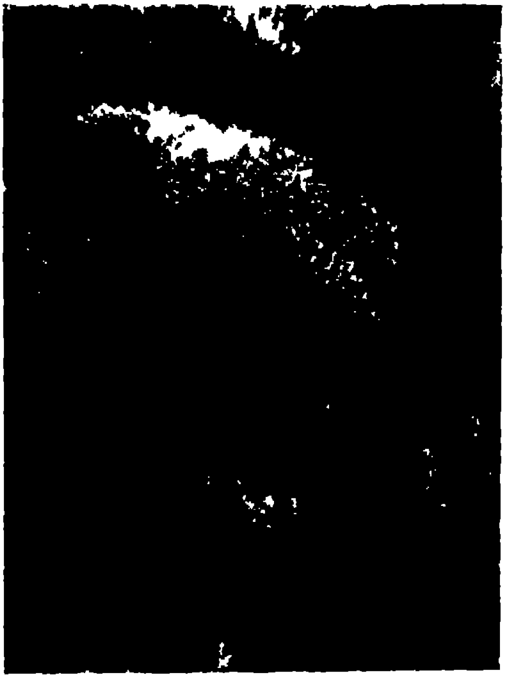

Fig 9 — Photomicrograph of sample No 20

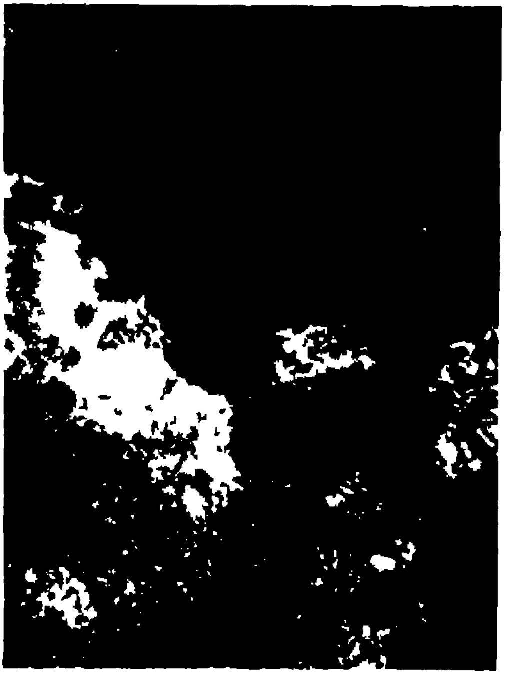

Fig 10 — Photomicrograph of sample No 21

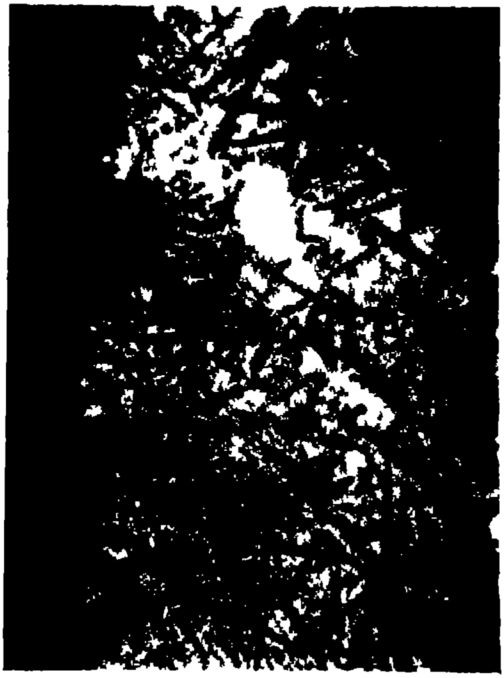

Fig 11 — Photomicrograph of sample No 7

that higher temperatures alone do not produce more mullite

These conclusions are more clearly brought out in Tables IV and V.

TABLE IV

FIRING No	BURNING PROCESS	COOLING PROCESS	PERCENTAGE OF MULLITE		
			Casting	Pressing	Extrusion
3	slow	slow	25.33	24.9	24.66
5	slow	quick	21.77	22.39	21.06
6	slow	slow	25.02	25.12	24.72
8	quick	quick		22.53	

TABLE V

METHOD OF MAKING	PERCENTAGE OF MULLITE		
	1,300 C	1,400 C	1,580 C
Casting	10.30	21.77	
Pressing	6.36	22.39	10.4
Extrusion	86	21.06	

Table IV shows that if cooling is quickly effected slow burning does not favour mullite formation This shows that the mullite formed remains in solution, and recrystallizes out on slow cooling At low temperatures such as in (d) thin castings give optimum yields of mullite Very slow firing as in (e) and (f) produces a maximum yield of mullite with pressed specimens Articles produced by extrusion always give low yields Pressing and casting are presumably better than extrusion for producing porcelain ware Microscopic examination of thin sections reveals that wherever undissolved quartz occurs in the body mullite needles are absent Figs 1 2 and 3, which relate to samples obtained by quick cooling, show undissolved quartz mullite crystals are conspicuously absent Dissolution of quartz during cooling influences mullite formation Slow cooling up to 1,200°C helps to dissolve the quartz (FIG 9) Quartz is absent in Fig 11, the sample was cooled quickly. This is probably due to the high firing temperature employed Small mullite needles are observed in specimen 15 (FIG 3) subjected to slow heating, though it was not cooled slowly, showing thereby that slow firing helps mullite formation

Samples 6 12 13 16 19, 20 and 21 (FIGS. 4-10) show marked similarity in structure All of them show a ground of molten glass in which medium-sized mullite needles are distributed These specimens were burnt and cooled slowly Sample 7 (FIG 11) shows a good distribution of big mullite needles This sample was fired at the highest temperature employed in the series and was practically melted The low viscosity of the molten mass may have been responsible for the growth of long needles though the sample was fired and cooled quickly

Conclusions

1 The formation of mullite crystals in a porcelain body is favoured by slow firing (24 hr) and slow cooling (54 hr)

2 The size of mullite crystals increases with the temperature of firing

3 High temperatures are not essential for the maximum formation of mullite.

4 Articles obtained by pressing and casting contain more mullite than those obtained by extrusion

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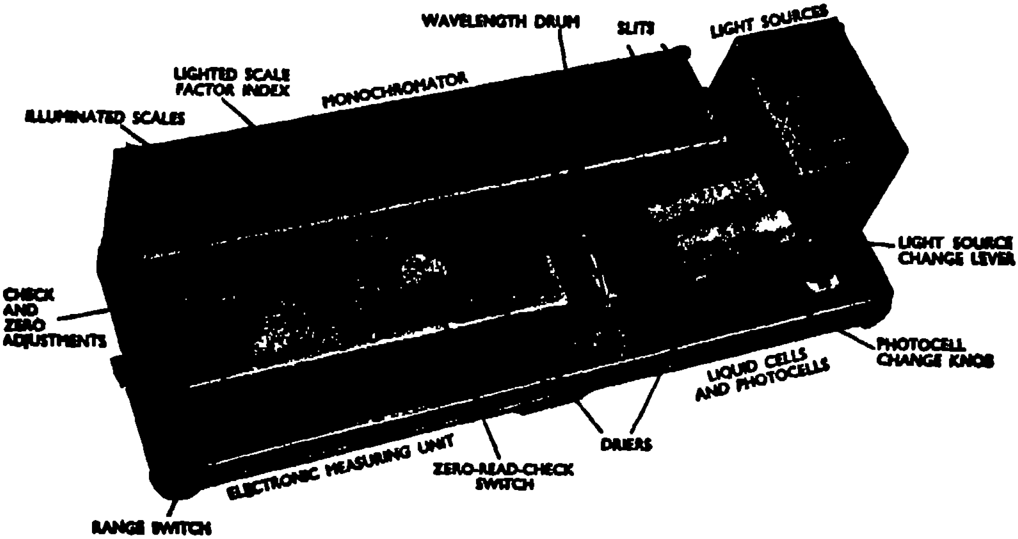

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A New Type of Scale-of-two Unit

B RAMACHANDRA RAO

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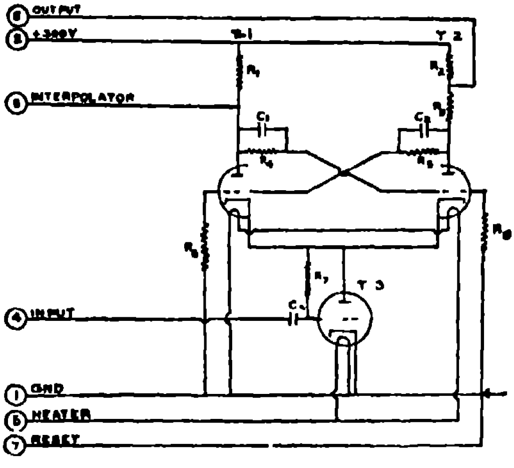
A new scale-of-two unit is described in which the triggering of scaling units is effected by the use of triodes as auto-bias as well as input. The circuit is sensitive and reliable in operation.

SCALING circuits are very widely used in nuclear counters to circumvent the limitations of the mechanical register by reducing the rate of counting A single scale-of-two unit reduces the number of pulses to half, two such units to one-fourth and so on In all modern types of counters these scaling circuits are constructed as replaceable plug-in units so that if any single scale-of-two unit is defective it is immediately replaced by a new one

The well-known thyratron scaling circuit of Wynn-Williams[1] has been subsequently superseded by a number of high-speed vacuum tube circuits Many such circuits based upon the trigger circuit of Eccles and Jordan[2] were developed by a number of workers[3-10] Lewis[4] employed inductance coils and cuprous oxide rectifiers in the grid circuit whereas subsequent modifications employed condensers The circuit devised by Lifschutz and Lawson[5] uses three 6C5 triodes, two of which are connected in the manner of Eccles and Jordan circuit and the third one negatively biased so as to respond to positive pulses only Another circuit suggested by Reich[7] employs two pentodes in such a manner that the circuit has a high sensitivity to negative pulses only A new method of triggering is employed in Don DeVault's[8] scaling circuit in which the tripping pulses are applied to the cathodes of the scaling triodes In this circuit only positive pulses are effective because negative pulses will leak off through the conducting tube The resolving time of this circuit is 170 microseconds Subsequently this circuit has been simplified by Don DeVault[9] by using a double triode 6SC7 and eliminating choke coils in the plate circuit, but it requires careful adjustment of the cathode resistor for reliable operation Further, the high resolving time of this circuit imposes a limitation on its use in the first stages of a counter employed for high rate of counting. The Higginbotham's[10] circuit is a replaceable plug-in type of unit and is one of the latest type This circuit employs a double triode of the type 6SN7 or 6SL7 as scaling tubes connected together in the manner of the Eccles-Jordan circuit so as to assume one of the two stable states The triggering from one state to another by an input pulse is effected by means of a double diode 6H6. It is essential in this circuit to keep the filament of the double diode at the potential of the high tension and hence a separate secondary winding is necessary for feeding the filaments of the diodes The resolving time of this circuit using 6SN7 is about 5 microseconds A number of these units have been constructed by the author on an open type of aluminium chassis of dimensions 3" × 2" × 2" and have been in constant use in the laboratory

A scale-of-two unit, in which a new method of triggering the scaling tubes is effected, is proposed here (FIG 1) As in Higginbotham's circuit, a 6SN7 tube is used for scaling triodes but the auto-biasing arrangement for the scaling tubes is replaced by a miniature triode T_3 whose maximum plate potential is very



T-1 and T-2, 6SN7 , T-3, 9002 , R_1, 20K , R_2 2K , R_3 18K , R_4 and R_5, 200K , R_6 and R_8, 100K , R_7, 0 5 meg , C_1, C_2 and C_3, 50 pf

Fig 1 — Circuit of scale of-two

nearly equal to the required auto-bias voltage The characteristics of valve T_3 must be such that at the maximum plate potential and zero grid bias it is at the positive end of the I_p-E_g characteristic and draws an amount of current approximately equal to that of triode T_1 or T_2 in conducting state Valve 9002 is very nearly found to satisfy these conditions and has got the additional advantage that it requires the same filament voltage as 6SN7 Pulses from the previous stage are applied to the grid of valve T_3 through a 50 pf mica condenser with a grid leak of 5,00,000 ohms. That the triggering from one state to another is achieved only by negative pulses can be easily seen As the valve T_3 is drawing almost saturation current, a positive input pulse at the grid of T_3 will not be able to change the plate current and hence the circuit will not respond to positive pulses On the other hand, a negative pulse at the grid of T_3 will reduce the plate current of T_3 and initiate the triggering from one stable state to another in the usual manner This method of triggering the scaling tubes by the use of a triode as auto-bias as well as input is new and quite reliable in operation The circuit is highly sensitive because of the additional amplification obtained by the triode 9002 and a pulse of one volt or even less will be able to trigger the unit unlike the Higginbotham's circuit which requires considerably higher voltages for triggering The high sensitivity of the unit made it possible to take a small output voltage for coupling to the next scaling unit, thereby reducing the effect of the output load on the scaling action of the first unit The circuit has got the additional advantage that the scale-of-two unit is made extremely compact The author has constructed the unit on an open aluminium chassis of dimensions 2¼″ × 1¼″ × 1¼″, the complete unit weighing only 100 gm Further, as the filaments of both the valves can be maintained at ground potential, a single 6 3-volt secondary tap on the power transformer is sufficient whereas in Higginbotham's unit two separate 6 3-volt taps are necessary Though the number of components used on this circuit are the same as in Higginbotham's circuit, heavy components required for auto-biasing and valve 6H6 in the latter circuit are replaced by a miniature valve 9002, 50 pf condenser and a one-fourth watt resistance, thus enabling the circuit to be made highly compact and light A number of these units are constructed by the author and are in regular use in this laboratory, the performance being quite satisfactory Fig 2 shows the new unit (b) photographed with the Higginbotham's unit (a) for comparison and shows the layout of the components This circuit is being developed further and a detailed analysis together with the technical data will be shortly published

I am highly indebted to Professor C Mahadevan for the help and encouragement

(a) (b)

Fig 2

during this work and to the Council of Scientific & Industrial Research under whose auspices the work was carried out

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Studies in the Syntheses of Quinolino-α-Pyrones—Part II

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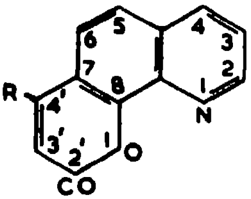
Chemical Laboratories C S I R Delhi

The synthesis of four new bases quinolino 8 7 α pyrone ($C_{12}H_7O_2N$) quinolino 8 7 α (4 methyl) pyrone ($C_{13}H_9O_2N$) quinolino 8 7 α (3 4 cyclopenteno) pyrone ($C_{15}H_{11}O_2N$) and quinolino 8 7 α (3 4 cyclohexeno) pyrone ($C_{16}H_{13}O_2N$) have been effected according to the method of Pechmann

IN the preceding communication[1] the synthesis of some new quinolino α pyrones by the condensation of β keto esters with 6 aminocoumarin and subsequent cyclization after the method of Conrad and Limpach[2] was reported The present paper describes the synthesis of some further new bases of the series by the application of Pechmann[3] reaction to 8 hydroxy quinoline with β keto esters Bobranski and Kochanska s synthesis[4] of quinolino 7 8 α pyrone from 7 hydroxy quinoline and malic acid appears to be the only earlier work in this line

Four new bases namely quinolino 8 7 α pyrone $C_{12}H_7O_2N$ (I) quinolino 8 7 α (4 methyl) pyrone $C_{13}H_9O_2N$ (II) quinolino 8 7 α (3 4 cyclopenteno) pyrone $C_{15}H_{11}O_2N$ (III) and quinolino 8 7 α (3 4 cyclohexeno) pyrone $C_{16}H_{13}O_2N$ (IV) have been synthesized by the condensation of 8 hydroxy quinoline with malic acid ethyl acetoacetate ethyl cyclopentanone 2 carboxylate and ethyl cyclohexanone 2 carboxylate respectively

These bases which are obtained in nearly theoretical yields are sparingly soluble in common organic solvents and give all the colour tests and precipitation reactions with the usual alkaloidal reagents Unlike the bases described in Part I of the series these are strongly basic in character as there is no phenolic hydroxyl group in the molecule and form stable hydrochlorides which are fairly soluble in water They are insoluble



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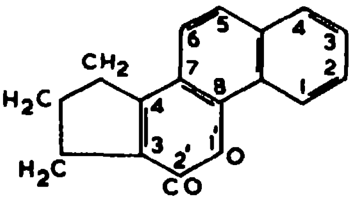
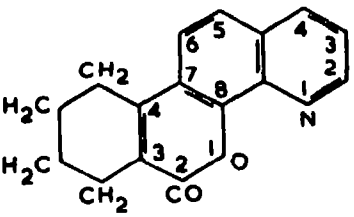


III



IV

in dilute alkalies but on refluxing with alcoholic alkali they go into solution (with a deep yellow colour) on account of the opening up of the lactone ring

Experimental

Quinolino 8 7 α *pyrone* $C_{12}H_7O_2N$ (*I*—) To absolute acetone (50 c c) was added 8 hydroxy quinoline (1 45 gm) malic acid (1 5 gm) and freshly fused zinc chloride (3 gm) and the reaction mixture was refluxed on the water bath for half an hour After cooling it was filtered and the residue washed with water dilute alkali and then repeatedly with water The base thus obtained was purified through solution in hydrochloric acid followed by precipitation with dilute sodium hydroxide solution and crystallized from cyclohexanone when greenish yellow needles m p (above) 360°C (decomp) readily soluble in warm cyclohexanone fairly soluble in xylene and insoluble in other organic solvents were obtained yield 85 per cent Found N 7 13 per cent $C_{12}H_7O_2N$ requires N 7 11 per cent

Hydrochloride — Pale yellow needles m p 242°C (decomp)

Chloroplatinate — Yellow needles m p 205°C (decomp)

Picrate — Deep yellow rhombic crystals m p 211°C

Quinolino 8 7 α (4 *methyl*) *pyrone* $C_{13}H_9O_2N$ (*II*)—8 Hydroxy quinoline (5 gm) was heated with an excess of ethyl aceto acetate (7 5 gm) in the presence of freshly fused zinc chloride (5 gm) at 140°C in an oil bath for 5 min The reaction mixture was cooled the solidified product treated with a 20 per cent solution of caustic soda filtered and washed repeatedly with water The base thus obtained was crystallized from cyclohexanone yellow needles m p (above) 360°C (decomp) fairly soluble in hot xylene and cyclohexanone yield 95 per cent Found N 6 66 per cent $C_{13}H_9O_2N$ requires N 6 63 per cent

Hydrochloride—Yellow needles m p 257°C

Chloroplatinate — Brown-coloured needles m p 282°C (decomp)

Picrate — Yellow rhombic crystals m p 205°C

Quinolino 8 7 α (3 4 *cyclopenteno*) *pyrone* $C_{15}H_{11}O_2N$ (*III*) — A mixture of 8 hydroxy quinoline (1 gm) cyclopentanone carboxylic ester (1 1 gm) and freshly fused zinc chloride (2 gm) was heated gradually in an oil bath the temperature being allowed to rise up to 140°C in the course of half an hour and then maintained at that point for 5 min The cooled mass was treated with water filtered and successively washed with water dilute alkali (5 per cent) again with water and then acetone dried and crystallized from cyclohexanone when yellow needles m p 360°C (decomp) fairly soluble in warm cyclohexanone were obtained yield 80 per cent Found N 5 98 per cent $C_{15}H_{11}O_2N$ requires N 5 91 per cent

Hydrochloride — Pale yellow rectangular plates m p 252°C

Chloroplatinate — Deep-yellow needles m p 207°C

Picrate — Bright yellow needles m p 202°C

Quinolino 8 7 α (3 4 *cyclohexeno*) *pyrone* $C_{16}H_{13}O_2N$ (*IV*) — A mixture of 8 hydroxy quinoline (1 45 gm) cyclohexanone carboxylic ester (1 8 gm) and freshly fused zinc chloride (2 gm) was heated in an oil bath at 140°C for 5 min The reaction product was worked up by following the procedure for base III and the resulting base crystallized from cyclohexanone as deep yellow needles m p 346°C (decomp) highly soluble in warm cyclohexanone yield 85 per cent Found N 5 62 per cent $C_{16}H_{13}O_2N$ requires N 5 58 per cent

Hydrochloride — Pale yellow rectangular plates m p 259°C (decomp)

Chloroplatinate — Brown needles m p 220°C (decomp)

Picrate — Deep yellow rhombic crystals m p 214°C

Studies in the pharmacological activity of these compounds are projected and further work in this line is in progress

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Studies in the Partially Reduced 4-Hydroxy-benzo-(h)-quinolines

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The synthesis of 2-methyl-4-hydroxy-7 : 8 : 9 10-tetrahydro-benzo-(h)-quinoline ($C_{14}H_{15}NO$), 2 : 3 - cyclopentano - 4 - hydroxy - 7 8 : 9 : 10 - tetrahydrobenzo - (h) - quinoline ($C_{16}H_{17}NO$) and 2 . 3 cyclohexano-4-hydroxy-7 : 8 9 : 10 - tetrahydrobenzo - (h) - quinoline ($C_{17}H_{19}NO$) has been carried out in two steps employing the Conrad-Limpach reaction

4-HYDROXY quinolines are of interest as many of the plant alkaloids are derived from them These include the angostura alkaloids[1] and those from some plants of the *Rutaceae* family[2] Further, 4-hydroxy quinolines form the starting-point in the synthesis of 4-alkylaminoquinolines which have found considerable use in the treatment of malaria On the other hand, 5 6-benzoquinolines (β-napthoquinoline) are noted for their marked physiological activity[3] A good deal of work has been done on the synthesis of completely aromatic benzoquinolines and their derivatives[4 8] but the synthesis of benzoquinolines, reduced in the benzene ring, appears to be limited to the work of Bachman and Wetzel[9], and Lindner and Zaundauer[10] In consideration of the facts referred to above, synthesis of partially reduced benzoquinolines, containing also, in the 4-position, a hydroxyl group, which could be replaced by an alkylamino group, was undertaken

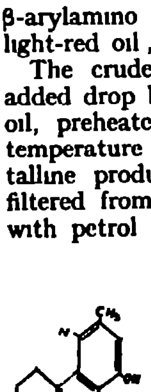
The present paper describes the synthesis of 2 - methyl - 4 - hydroxy - 7 8 9 10 - tetra-hydro - benzo - (h) - quinoline, $C_{14}H_{15}NO$ (I), 2 3 - cyclopentano - 4 - hydroxy - 7 8 9 10 - tetrahydro-benzo-(h)-quinoline, $C_{16}H_{17}NO$ (II) and 2 3 - cyclohexeno - 4 - hydroxy - 7 8 9 10 - tetrahydro - benzo - (h) - quinoline, $C_{17}H_{19}NO$ (III) These bases have been synthesized in two steps by the application of the Conrad-Limpach reaction[11] The general procedure followed consisted of (1) condensation of the tetrahydro-α-napthyl amine with the appropriate β-keto-ester by allowing the reaction mixture to stand overnight in the presence of a drop of hydrochloric acid (1 1) and (2) cyclization of the condensation product by adding it slowly to paraffin oil, preheated to 270°C, filtering off the paraffin and crystallizing the cyclized product from a suitable solvent

The hydrochlorides and sulphates, both of which get readily hydrolysed in water, and 4-chloro-derivatives of the bases have been prepared The weak basic character of these substances is due to the presence of a phenolic hydroxyl group which is also responsible for their solubility in dilute alkali All the bases give precipitates with Dragendorff's reagent in acetic acid solution

Experimental

2 - *Methyl* - 4 - *hydroxy* - 7 8 9 10 - *tetra-hydro-benzo-(h) quinoline* (*I*) — 3 gm (0 02 mol) of tetrahydro-α-naphthylamine was added to 4 gm (0 03 mol) of acetoacetic ester and the mixture kept overnight adding a drop of hydrochloric acid (1 1) It was then taken up in ether and the ethereal solution was successively washed with water, dilute caustic soda solution and again with water, dried over anhydrous sodium sulphate and freed of the solvent The intermediate β-arylamino acrylate was obtained as a light-red oil, yield, 4 5 gm

The crude intermediate (3 5 gm) was added drop by drop to 40 gm of paraffin oil, preheated to 270°C, and kept at this temperature for 5 min On cooling, a crystalline product separated out which was filtered from the paraffin oil after dilution with petrol ether, thoroughly washed with



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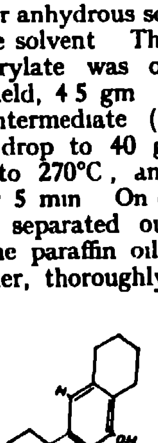

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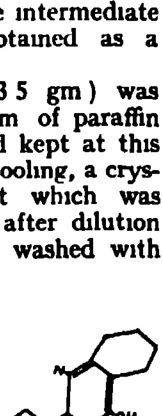

III

the same solvent and crystallized from alcohol when colourless needles (m p 298°C) insoluble in most organic solvents but soluble in alcohol and sparingly so in pyridine were obtained yield 2 2 gm Found C 78 47 H 7 38 N 6 05 $C_{14}H_{15}NO$ requires C 78 87 H 6 91 N 6 58 per cent

Hydrochloride — It came out almost immediately after initial solution of the base in conc HCl as colourless needles which after filtration through a sintered funnel and washing with a little alcohol and ether melted at 310°C (decomp)

Sulphate On careful concentration of a solution of the base in 50 per cent sulphuric acid the sulphate came out in colourless needles which after filtration and washing with alcohol and ether melted at 245°C (decomp)

2 *Methyl* 4 *chloro* 7 8 9 10 *tetrahydro benzo* (*h*) *quinoline* 0 1 gm of (I) was refluxed on the water bath for 2 hr with an excess of $POCl_3$ then poured on crushed ice stirred decomposed with 2 c c of conc hydrochloric acid and filtered On making the filtrate ammoniacal a white precipitate was thrown down which was washed and dried on porous tile and crystallized from alcohol m p 120°C

2 3 *Cyclopentano* 4 *hydroxy* 7 8 9 10 *tetrahydro benzo* (*h*) *quinoline* (*II*) — It was prepared according to the method described for the preparation of (I) using cyclo pentanone carboxylic ester in place of aceto acetic ester for the reaction with the amine The crude cyclized product was charcoaled in boiling absolute alcohol from which it crystallized in colourless needles m p 343° 45°C insoluble in most organic solvents but soluble in pyridine and moderately in alcohol yield of the intermediate product (theoretical) was 5 7 gm and the yield of the cyclized product was 42 per cent on the weight of the intermediate Found C 79 57 H 7 33 N 5 75 $C_{16}H_{17}NO$ requires C 80 33 H 7 11 N 5 85 per cent

Hydrochloride — M p 300°C (decomp)

Sulphate — M p 250°C (decomp)

4-*Chloro derivative*—M p 110°C

2 3 *Cyclohexano* 4 *hydroxy* 7 8 9 10 *tetrahydro benzo* (*h*) *quinoline* (*III*) — It was prepared in a similar manner using cyclo hexanone carboxylate for the initial condensation with the amine The crude cyclized product crystallized from boiling absolute alcohol in colourless needles m p 346° 48°C (decomp) insoluble in most solvents but soluble in pyridine and moderately in alcohol The yield of the intermediate (light red oil) was 7 3 gm and that of the cyclized product 46 per cent on the weight of the intermediate Found C 79 61 H 7 51 N 5 80 $C_{17}H_{19}NO$ requires C 80 63 H 7 51 N 5 53 per cent

Hydrochloride — M p 275°C (decomp)

Sulphate — M p 162°C (decomp)

4 *Chloro derivative* — M p 124° 25°C

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Stability of Oil Varnish Emulsions

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The stability of an oil emulsion varnish under storage is affected by the phase volume ratio of the system as well as by the concentration of the emulsifying agent. An increase in the phase volume ratio gives more stable emulsions containing finely dispersed particles, provided the system contains a minimum concentration of the emulsifying agent

ONE of the interesting developments in the field of paint technology during 1939-47 has been the development of emulsion paints — a new type of surface coating, using water as a diluent instead of thinners like turpentine and white spirit This product, as prepared in the earlier years, suffered from several drawbacks, particularly that of inferior weathering properties and flatness of finish, but as a result of intensive research these defects have been overcome and now these emulsion paints have not only come to stay but are rapidly ousting out of the market the conventional oil paints by virtue of their cheapness, ease of handling and other good qualities

While the manufacture of emulsion paints has made rapid progress, particularly in America, this has not been accompanied by a study of the fundamental principles of emulsion paint technology as applied to their manufacture Most of what has been published on the subject during the last 12 years is in the form of patent literature, or it deals with some practical aspect of the problem and even to this day the manufacturer arrives at his final working formulae and processes more as a result of empirical experiments than on any well-understood principles Hence, there is good scope for work on the mechanism underlying the formulation of emulsion paints

The object of the present work was to determine the important property of storage stability of the emulsion vehicle before it was pigmented and see how far the size frequency analysis of the samples was able to throw light on the gradual degradation of the system and to find out the extent to which the stability of the system was affected by changes in the phase volume ratio and the amount of the emulsifying agent Soap-stabilized emulsions have received more detailed study than any other type and hence were considered suitable systems for this work to start with

Harkins and Beeman[1] carried out a series of size frequency analyses on soap-stabilized emulsions and recommended the study of the change in diameter, area and volume distribution of the emulsified particles with ageing as a method for determining stability King and Mukherjee[2] have applied the size frequency method to compare emulsions stabilized by soaps and under different conditions For our experiments an emulsion of a medium oil varnish stabilized by soap was chosen for investigation Ammonium oleate was considered the best soap to be used as it contained a volatile alkali and would not give pronounced hydrophylic properties to the dried varnish film

In this connection it may be noted that the two aspects of the problem investigated, namely the effect of phase volume ratio and that of concentration of the emulsifying agent in affecting the stability of the emulsion, are particularly significant in the case of emulsion paints The vehicle for such a paint is a varnish emulsion which has to be stable for a length of time before it is pigmented If the stability of the emulsion vehicle is unaffected by an increase in the phase volume ratio, a given volume of the vehicle will contain a greater quantity of the internal phase which ultimately becomes the film-forming material leading to greater economy of space and transport Regarding the emulsifying agent, if the emulsion could be stabilized with a minimum of the emulsifying agent, the dried film would have better water resistance The present investigation examines these two aspects of emulsion paints and in addition attempts to correlate stability and water resistance properties by means of a new factor

Experimental

Reagents & Apparatus

Boiled linseed oil (to I S D specifications)

Ester gum (Shalimar) — Acid value 8 5

Staining dye — Sudan G — obtained as a brown powder by diazotizing aniline and coupling the same with β naphthol It was insoluble in water and acids and soluble in turpentine and varnish staining the latter orange

Medium oil varnish — Estergum (200 gm) was melted in an enamelled pot and boiled linseed oil (200 gm) added gradually with stirring The contents were cooked for about 30 min cooled and 60 c c turpentine added to reduce the viscosity to 8 poises at 85°F To this the dye (2 gm) was added

Aqueous ammonia — 3 5 per cent solution

Oleic acid — Technically pure

10 per cent gelatine solution in water

Reading graph — A transparent graph sheet to measure particle diameter up to 0 5 mm was prepared as follows The lines in the middle portion of a graph sheet measuring 8" × 8" were intensified with black ink The paper was hung vertically and was illuminated sufficiently by diffused light The distance of a copying camera from this graph was so adjusted that the image formed on the ground glass screen measured exactly 8 cm × 8 cm After a sharp focus the exposure was made A contact print obtained served as a transparent graph

The emulsion varnish samples were prepared according to Table I in 20 c c pyrex glass tubes

The required quantity of the varnish was taken in a test tube oleic acid and water added and finally aqueous ammonia from a microburette to form the emulsifying agent *in situ* The contents were shaken for about 10 min One c c of the emulsion was pipetted out immediately mixed with one c c of 10 per cent gelatine solution and a drop of the mixture placed on a microscopic slide and covered with a watch glass 30 min were allowed for the emulsion to set completely in the gelatine Meanwhile the photomicrographic equipment was got ready To start with the camera was calibrated for reduction in magnification obtained in the eyepiece of the microscope This was done by placing a piece of graph paper with a square hole of 2 mm side in the centre immediately below the eyepiece The camera was brought immediately above the eyepiece and the width of the image obtained on the screen measured This gave a value of 12 5 mm By the naked eye the eyepiece gave a magnification 10 times i e a square of 20 mm side For the experimental emulsion the magnification used was 400X and hence the photomicrograph obtained on the camera would have magnified the particles only 250 times An enlarged positive print was obtained to get 1 000 magnification for the particles Thus photomicrographs were obtained for all the samples immediately they were prepared and after a period of 3 days and 6 days The exposure time was 2 to 3 min Any free phase separating during this storage was removed before photographing Figs 1 2 and 3 are photomicrographs of sample (6) The decrease in the fineness of dispersion with ageing is evident from the same Figs 4 5 and

TABLE I COMPOSITION OF EMULSION VARNISH

(10 *gm prepared*)

Sample No	Wt of varnish gm	Wt of oleic acid gm	Ammonia added c c	Wt of water gm	Oil phase %	Aqueous phase %	Emulsifying agent %	Emulsifying agent based on 100 gm oil phase %
1	2	0 094	0 35	7 65	20	79	1	5
2	2	0 188	0 70	7 30	20	78	2	10
3	2	0 282	1 00	7 00	20	77	3	15
4	3	0 094	0 35	6 65	30	69	1	3 3
5	3	0 188	0 70	6 30	30	68	2	6 6
6	3	0 282	1 00	6 00	30	67	3	10
7	4	0 094	0 35	5 65	40	59	1	2 5
8	4	0 188	0 70	5 30	40	58	[illegible]	5
9	4	0 282	1 00	5 00	40	57	3	7 5

6 represent the photomicrographs of freshly prepared samples (7), (4) and (1) having a varying phase volume ratio Comparing the same, it will be seen that a higher phase volume ratio gives rise to finer dispersions

Size frequency analysis was done on the basis of the photomicrographs as follows Since the emulsion particles were seen magnified 1,000 times, a particle of 1 micron diameter would occupy a square of 1 mm on the photomicrograph The total number of particles in the size range of 0 5μ to 10μ was determined by actual counting and the diameter of each particle measured with the help of the transparent graph The particles were then arranged in their size order The percentage of particles having the same diameter to the total number of particles

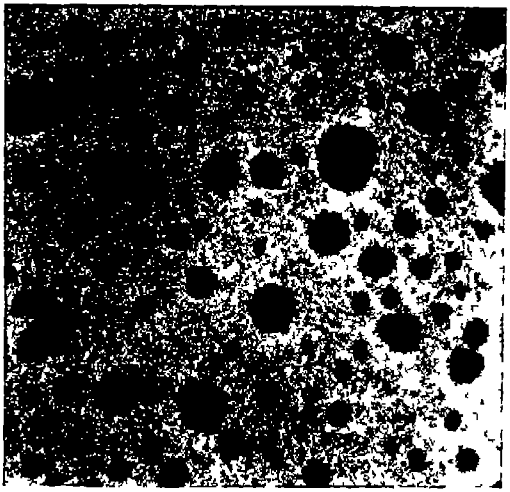


FIG 1 — PHOTOMICROGRAPH OF EMULSION VARNISH SAMPLE (6) IMMEDIATELY AFTER ITS PREPARATION (1000X)

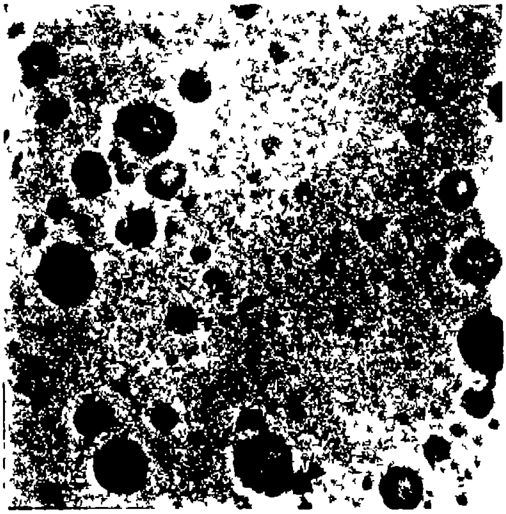


FIG 3 — PHOTOMICROGRAPH OF EMULSION VARNISH SAMPLE (6) AFTER 6 DAYS AGEING (1000X)

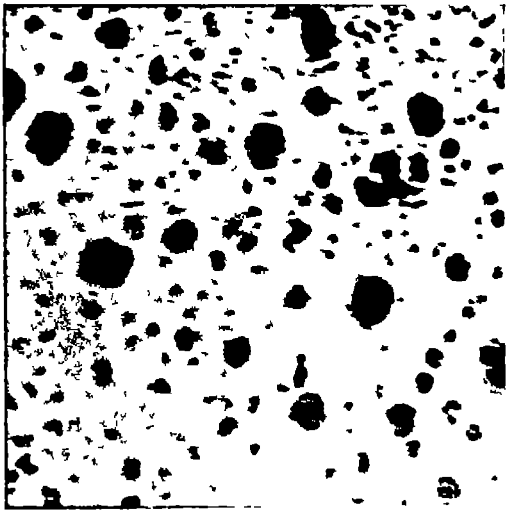


FIG 2 — PHOTOMICROGRAPH OF EMULSION VARNISH SAMPLE (6) AFTER 3 DAYS AGEING (1000X)

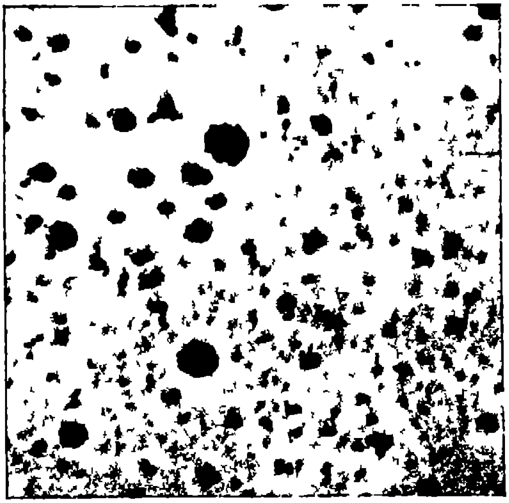


FIG 4 — PHOTOMICROGRAPH OF EMULSION VARNISH SAMPLE (7) IMMEDIATELY AFTER ITS PREPARATION (1000X)

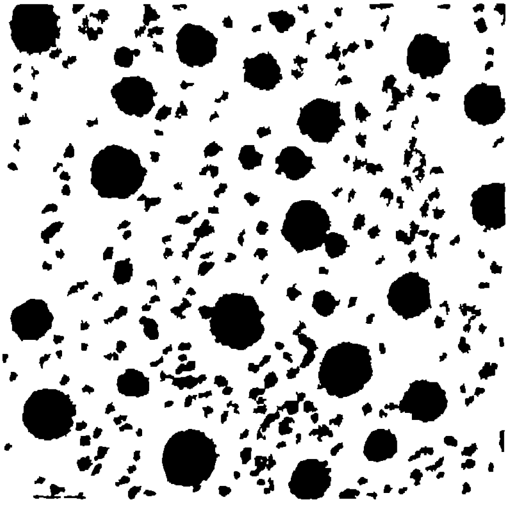


FIG. 5 — PHOTOMICROGRAPH OF EMULSION VARNISH SAMPLE (4) IMMEDIATELY AFTER ITS PREPARATION (×1000)

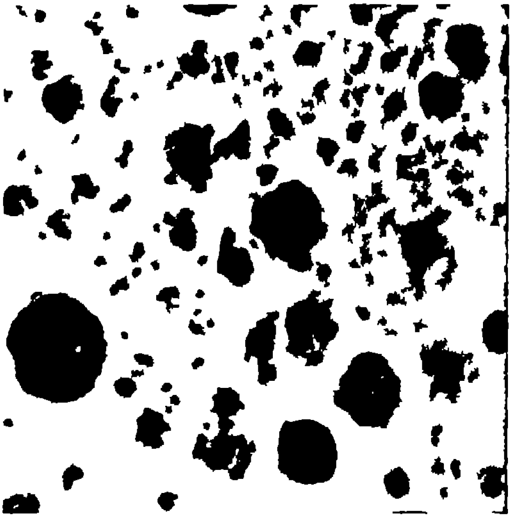


FIG. 6 — PHOTOMICROGRAPH OF EMULSION VARNISH SAMPLE (1) IMMEDIATELY AFTER ITS PREPARATION (×1000)

in the area was determined for each size in the range. Similarly, the per cent by volume occupied by particles having equal diameters to the total volume occupied by all the particles in the area was calculated for each size in the range. The results obtained in the case of sample (8) are recorded in Tables II, III and IV. The numerical distribution curves were obtained by plotting the values in column 1 against those in column 3. The volumetric distribution curves were obtained by plotting the values in column 1 against those in column 5. Figs. 7 and 8 represent the former and Figs. 9 and 10 represent the latter for the samples (1) and (3).

TABLE II — SIZE FREQUENCY ANALYSIS OF SAMPLE (8)

Readings taken immediately after preparation of emulsion; projected area 15.5 × 13.5 μ; magnification 1000X

PARTICLE DIAMETER	NUMBER OF PARTICLES	TOTAL NUMBER %	TOTAL VOLUME × 10⁶	TOTAL VOLUME %	INTERFACIAL AREA cm² × 10⁶	SPECIFIC INTERFACE m²/gm
0.5	1 8	30.41	0.00000707	0.27	0.8484	
1		2.80	0.00003225	1.23	1.935	
	47	17.1	0.0001968	7.518	5.904	
3	29	10.58	0.0004101	15.670	8.902	$\frac{40.3264}{0.002618 \times 0.9825} = 11\,580$
4	19	6.93	0.000636	24.320	9.562	
5	8	2.92	0C0 240	20.020	6.288	
6	4	1.46	0.0004520	17.270	4.52	
7	2	0.73	0.0003590	13.720	3.077	
8						
9						
10						
	274	99.98	0.0026172	100.020	40.3264	

TABLE III — SIZE FREQUENCY ANALYSIS OF SAMPLE (8)

(*Readings taken after the emulsion was stored for 3 days projected area* 15.5 × 13.5 *cm magnification* 1000X)

Particle diameter, microns	Number of particles	Total number %	Total volume cc × 10⁶	Total volume %	Interfacial area cm² × 10⁶	Specific interface cm²/gm
0.5	292	50.60	0.00001913	0.5363	2.2956	
1	160	27.73	0.00008384	2.351	5.0104	
2	77	13.31	0.0003226	9.044	9.678	
3	27	4.679	0.0003817	10.400	7.634	
4	4	0.693	0.000134	3.757	2.010	$\frac{50.056}{0.003567 \times 0.9825} = 14\,290$
5	3	0.520	0.0001965	5.509	2.358	
6	6	1.04	0.0000786	18.020	6.786	
7	5	0.866	0.0008980	25.180	7.698	
8	2	0.346	0.000536	15.030	4.020	
9	1	0.173	0.0003818	10.300	2.546	
10	0					
>10	0					
	577	99.957	0.00356747	100.0273	50.0560	

TABLE IV — SIZE FREQUENCY ANALYSIS OF SAMPLE (8)

(*Readings taken after the emulsion was stored for 6 days projected area* 15.5 *cm* × 13.5 *cm magnification* 1000X)

Particle diameter microns	Number of particles	Total number %	Total volume cc × 10⁶	Total volume %	Interfacial area cm² × 10⁶	Specific interface, cm²/gm
0.5	198	30.70	0.00001297	0.209	1.5564	
1	224	34.72	0.00011738	1.892	7.044	
2	116	18.04	0.00048604	7.832	14.5812	
3	55	8.507	0.00077770	12.530	15.554	
4	22	3.41	0.00073700	11.880	11.055	
5	15	2.326	0.00098250	15.830	11.790	$\frac{85.3692}{0.006205 \times 0.9825} = 14\,010$
6	7	1.085	0.00079210	12.760	7.921	
7	1	0.155	0.00017960	2.896	1.5396	
8	4	0.620	0.00107200	17.280	8.040	
9	0					
10	2	0.310	0.00104800	16.900	6.288	
>10	1	0.155				
	645	100.028	0.00620700	100.009	85.3692	

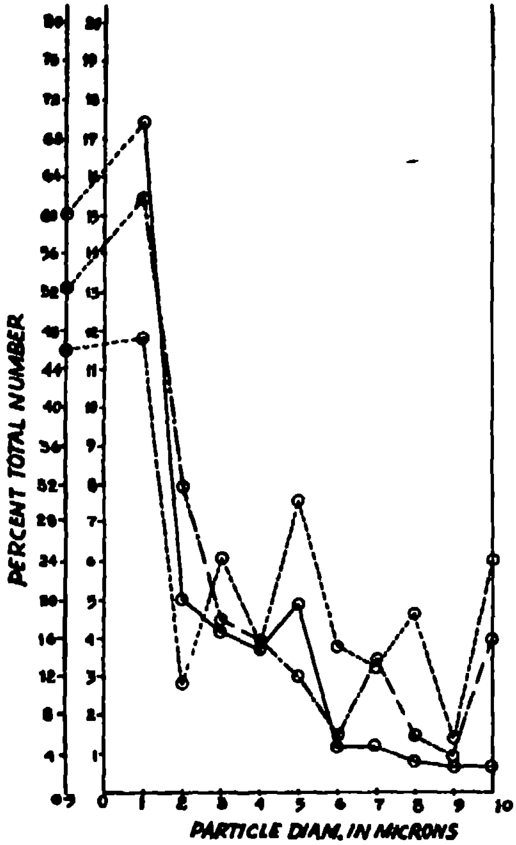
The interfacial area was then calculated for all the particles assuming a spherical size for them. Knowing the total volume occupied by all the particles (in the projected area) and the density of the varnish, the specific interface in sq cm/gm was calculated. Table V gives the values for specific interface in sq cm/gm for the various samples when freshly prepared and after ageing.

TABLE V — SPECIFIC INTERFACE OF EMULSION VARNISHES

Sample No	Oil phase %	Fresh sample	3 day old	6 day old
1	20	10190	8986	7879
2	20	10510	9223	8040
3	20	11050	9776	8363
4	30	11000	10990	10520
5	30	11800	11340	11200
6	30	12660	12390	11900
7	40	16550	12830	10300
8	40	15580	14290	14010
9	40	13740	13600	13350

On ageing there is a decrease in the interfacial area due to coalescence. A variation of specific interface with ageing provides useful information regarding the stability of the emulsion. This variation with time has been graphically represented in the case of samples (1) and (2) (FIG. 11).

King and Mukherjee[2] have defined emulsion stability quantitatively by means of the product of the initial specific interface and the reciprocal of the rate of decrease of interfacial area with time. Making use of the same relation, the stability factor for each of the samples under investigation was determined as follows. Since the variation of specific interface with time is known for each sample, the difference in the specific interface for the sample after the first part of storagy (0 to 3 days) was calculated and divided by the time lapse to get the rate of decrease of interfacial area with time. Similarly, knowing the difference in the value of specific



o——o, fresh sample o — — o 3 day sample
o - - - o 6-day sample

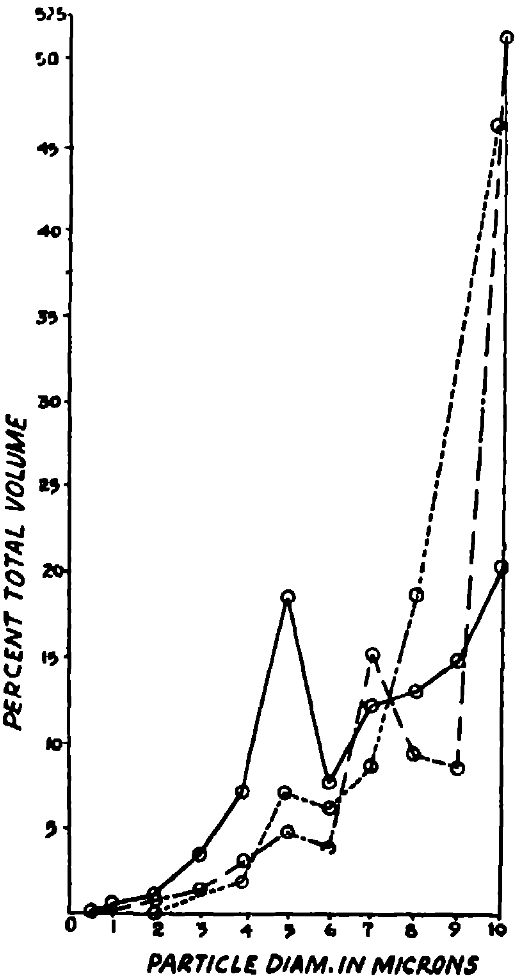
FIG 7 — NUMERICAL DISTRIBUTION CURVE FOR SAMPLE (1)

interface after the second part of storage (3 to 6 days), the rate for the second part was calculated. From these figures the average rate was determined and its reciprocal multiplied by original specific interface to give the factor of stability. Table VI gives the factor of stability for the different samples.

It is desirable to evaluate the water resistance properties of the paint films and correlate it with the stability of the emulsion paint. A new factor has been worked out to indicate the water resistance of the ultimate film consistent with storage stability, based on the following assumptions. The adsorbed film of the emulsifying agent was mono-molecular. The length of the oriented soap molecule[3] was 25 × 10^{8} cm and the

TABLE VI — STABILITY FACTOR OF EMULSION VARNISH SAMPLES

SAMPLE No	INITIAL SPECIFIC INTERFACE, cm²/gm (S)	DECREASE OF INTERFACIAL AREA WITH TIME, first period	DECREASE OF INTERFACIAL AREA WITH TIME, second period	AVERAGE RATE OF DECREASE OF INTERFACIAL AREA, days	STABILITY FACTOR, S × do/ds
1	10190	401 0	369	384	26 50
2	10610	429 0	394	412	25 50
3	11050	428 0	266	447	24 70
4	11000	3 3	157	80	137 50
5	11800	153 0	47	100	118 00
6	12860	90 0	167	128	100 00
7	16550	1240 0	676	958	17 28
8	15580	430 0	93	262	59 50
9	13740	47 0	83	65	211 40



o——o, fresh sample o — — o, 3-day sample,
o - - - o 6-day sample

FIG 8 — VOLUMETRIC DISTRIBUTION CURVE FOR SAMPLE (1)

weight of soap (sp gr 0 9) per sq cm of interface was $25 \times 10^{8} \times 1 \times 0\ 9 = 22\ 5 \times 10^{-8}$ gm/sq cm Since the specific interface was known for the samples the theoretical soap concentration to emulsify 100 parts of the oil phase was calculated as $22\ 5 \times 10^{8} \times$ sp interface $\times$ 100 gm soap/100 gm of oil varnish Assuming the absence of hydrolysis of soap the theoretical concentration of the emulsifying agent to emulsify 100 gm of oil varnish was calculated for the stable emulsions This value was compared with the actual concentration and the ratio of actual concentration to the theoretical was determined Greater the value of this ratio means greater the occlusion of the hydrophylic emulsifying agent in the ultimate varnish film By dividing the stability factor by this ratio λ the new factor was obtained Table VII indicates the results

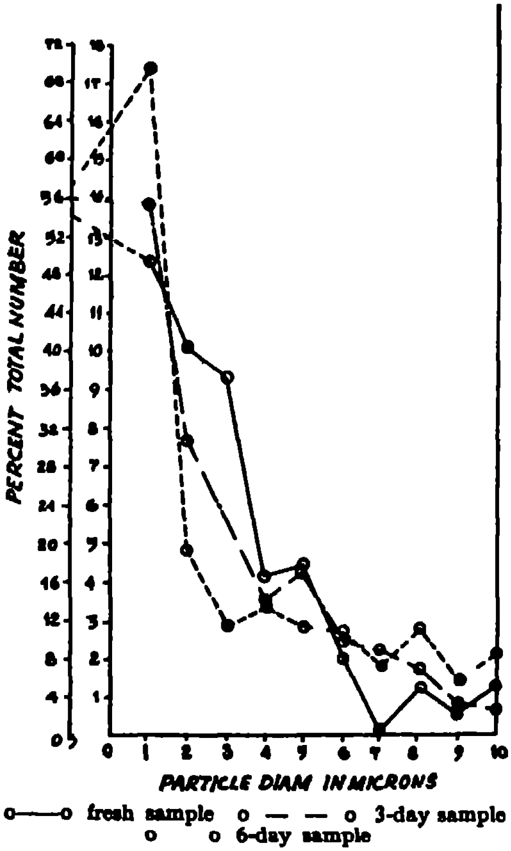


FIG 9 — NUMERICAL DISTRIBUTION CURVE FOR SAMPLE (3)

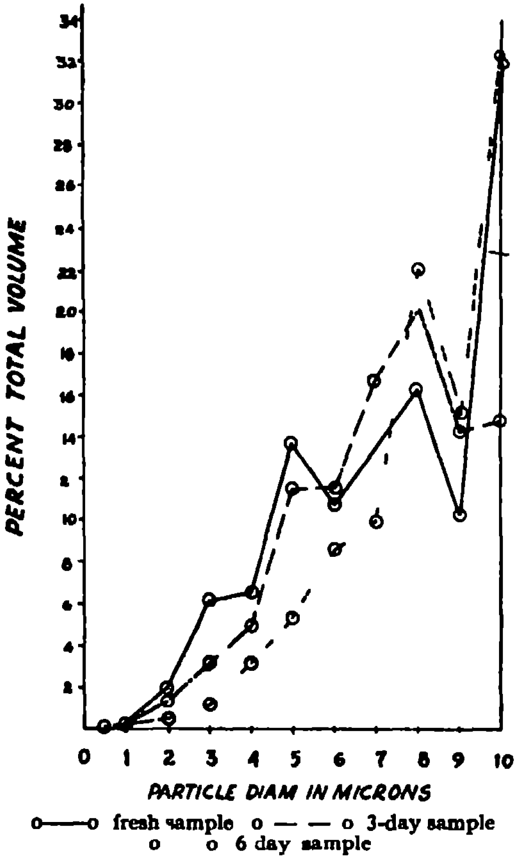


FIG 10 — VOLUMETRIC DISTRIBUTION CURVE FOR SAMPLE (3)

Discussion

A good deal of published literature is available on the effect of phase volume ratio

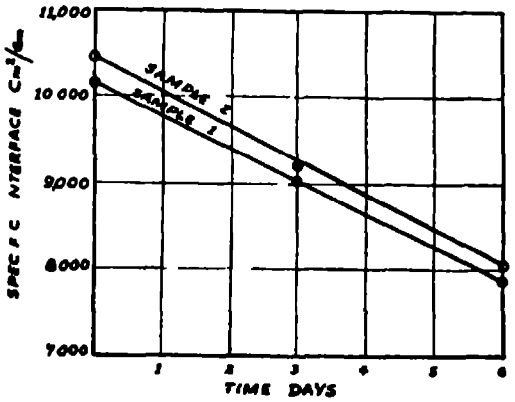


FIG 11 — VARIATION OF SPECIFIC INTERFACE WITH TIME

TABLE VII — RELATION BETWEEN THE STABILITY FACTOR OF THE EMULSION VARNISH TO THE RATIO OF ACTUAL & THEORETICAL CONCENTRATION OF EMULSIFYING AGENT

SAMPLE No	SPECIFIC INTERFACE (S) cm^2/gm	MINIMUM SOAP CONCN TO FORM MONOMOLECULAR FILM gm	THEORETICAL CONCN OF SOAP BASED ON 100 GM INT PHASE	ACTUAL CONCN BASED ON 100 GM INT PHASE	RATIO OF ACTUAL/ THEORETICAL CONCN OF SOAP	STABILITY FACTOR	QUALITY	λ RATIO OF STABILITY FACTOR TO THE RATIO OF ACTUAL/THEORETICAL CONCN OF EMULSIFYING AGENT
1	10190	0 002293	0 2293	5 0	21 8	26 5	Unstable	
2	10510	0 002368	0 2368	10 0	42 2	25 5	Unstable	
3	11050	0 002486	0 2486	15 0	60 3	24 7	Unstable	
4	11000	0 002475	0 2475	3 3	13 3	137 5	Unstable	
5	11800	0 002655	0 2655	6 6	24 8	118 0	Stable	118 0/24 8=4 8
6	12660	0 002849	0 2849	10 0	35 1	110 0	Stable	100 0/35 1=2 9
7	16550	0 003724	0 3724	2 5	6 7	17 3	Unstable	
8	15580	0 003506	0 3506	5 0	14 3	59 5	Stable	59 5/14 3=4 2
9	13740	0 003092	0 3092	7 5	24 2	211 4	Stable	211 4/24 2=8 7

on the stability of emulsions Hatschek[4] is of the opinion that the stability of an emulsion is generally not complete until the figure corresponding to closest packing namely a phase volume ratio of 74 06 is reached Zhukov and Buschmakin[5] on the other hand believe that an optimum relation corresponding to 1 1 exists for the formation of stable emulsions and that any divergence from this ratio results in a decrease of stability This view is supported by the work of Mattiello[6] Then again as an increase in phase volume ratio increases the internal viscosity this latter indirectly makes for better stability Whatever be the optimum phase volume ratio our experiments confirm that within the range studied an increase in phase volume ratio improves stability of emulsion varnishes It also gives rise to finer emulsions which is in agreement with the results obtained by Marshall[7]

According to the oriented adsorption theory the emulsifying agent gets adsorbed at the interface and serves as a protective film which resists the impact of the emulsified molecules in motion if the quantity of emulsifier added to the system is insufficient to protect the interface completely the system would obviously show signs of coalescence and instability Hence there is a theoretical minimum for the quantity of emulsifier required for securing stability In order to arrive at this figure however, it is very necessary to take into account all the important factors that come into play namely

1 The interfacial area of the disperse phase

2 The concentration of the emulsifying agent required to reduce the interfacial tension sufficiently to ensure emulsification

3 Structural compatibility of the non polar ends of the emulsifier and oil

4 Extent of hydrolysis of the emulsifying agent

5 The extent to which it goes into colloidal solution and its function in stabilizing the emulsion

6 The thickness of the interfacial film

The value of interfacial area solely depends on the degree of dispersion The interfacial area or more precisely the specific interface can be easily calculated from a size frequency analysis based on photomicrographic examination of the emulsion with reference to the values in Table VI

As regards the second factor the work of Quincke and Plateau[8] and that of Bancroft[9] has already shown how the lowering of the surface tension is intimately connected with emulsification and maintenance of stability The work of Harkins Brown and Davies[10] has shown that sodium oleate in a concentration of 0 03 N gives excellent emulsions with a reduction of interfacial tension between benzene and water from 35 0 ergs/sq cm to 2 2 ergs/sq cm Harkins and Zollman[11] have also shown that reduction of interfacial tension between water and benzene to below 10 dynes/sq cm permits easy emulsification and that 0 1 N sodium oleate is effective in reducing the same to 2 64 dynes/sq cm From all this data it is safe to assume that 0 1 N solution of soap will suffice to reduce tension to facilitate emulsification In our experiments a 3 per cent solution of ammonium oleate was used.

As regards structural compatibility, if the emulsifying agent is to remain at the interface, it is very necessary that the polar and non-polar portions of the molecule are of approximately equal strength[12] Ammonium oleate is more suitable as an emulsifying agent than sodium oleate by virtue of its weaker polar group giving it lesser tendency to be pulled into the aqueous phase and a non-polar end consisting of a fatty acid similar to that existing in the oil phase Hence, from the point of view of compatibility, it should be a satisfactory emulsifying agent

The hydrolysis of the soap would ordinarily be an important factor to be taken into account without which any estimation of the quantity of emulsifier required would be wide off the mark Unfortunately no data appears to have been published on the hydrolysis range for ammonium salts of the fatty acids though work has been done on the sodium and potassium salts[13] Though there is no published data for ammonium oleate, in view of the fact that it is a salt of a weak base, we would be justified in assuming that it would hydrolyse still less as compared with its corresponding sodium or potassium salt , hence in our experiments the effect of hydrolysis of the emulsifying agent may be taken to be negligible

The effect of the colloidal nature of soap solutions is of no importance in this particular set of experiments under consideration as colloidal solutions are not likely to form at the concentrations used

It is when we come to the question of the thickness of the interfacial film that we meet with a considerable divergence of views

Griffin and Rienmann[14,15] have shown that interfacial films are essentially monomolecular The investigations of Harkins and Beeman[16] support this view On the other hand, the work of Nanoka[17], Seymour, Tartar and Wright[18] and Ramsden and Seifriz[19,20] is against this view Thus, as far as our present knowledge goes, there is a good deal of divergence of opinion as to whether the interfacial film is monomolecular or polymolecular In actual industrial practice, the quantity of emulsifier used is rarely less than 6 times or more than 20 times the theoretical quantity required to form a monomolecular layer at the interface But if we remember that a good part of the emulsifier remains ineffective by remaining in solution in the outer phase and thus is not brought into action at the interface, and besides if we take into consideration the well-known tendency in industrial practice to err on the safe side, for purposes of evaluation of the minimum quantity of emulsifying agent required, we could assume that the interfacial layer is monomolecular

Thus, to sum up, in the particular state of emulsions we are concerned with, the main factors which determine the minimum quantity of emulsifying agent required to stabilize emulsions would appear to be the specific interface, lowering of the surface tension, extent of hydrolysis of the emulsifying agent, the thickness of the interfacial film and the extent to which the emulsifying agent remains in aqueous solution

Assuming 0 1 N as a suitable concentration of the emulsifying agent for optimum reduction of interfacial tension, and presuming that hydrolysis is negligible, the theoretical quantity of the soap necessary can be calculated on the basis that the interfacial layer is one molecule thick Table VII gives this figure in column 4 together with the actual concentration used in column 5 From this it will be seen that while samples (5) and (6) are stable, containing 6 6 per cent and 10 0 per cent of emulsifying agent based on 100 gm of the internal phase, samples (2) and (3) are unstable in spite of a higher concentration of the emulsifier This is very likely due to the fact that though stability is dependent to a great extent on the concentration of the emulsifying agent, it is also governed by the internal agitation of the droplets With a reduction in the phase volume ratio (20 per cent internal phase), the internal kinetic effect comes more into play overcoming the resistance of the interfacial film, resulting in a rupture of the same and coalescence of the particles The stability of samples (4) and (7) is poor because of insufficient emulsifying agent

Sample (8) is a stable emulsion This represents a phase volume ratio of 40 per cent and an actual concentration of 5 per cent of emulsifying agent based on 100 of the internal phase as against a theoretical figure of 0 3506, i e a ratio of actual to theoretical of 14 3

The excess indicated may be necessary for the formation of polymolecular films and to allow for the emulsifying agent not used up but remaining in the aqueous phase in solution without undergoing hydrolysis

While stability is an all important property in the case of emulsions in the case of emulsion varnishes or paints the resistance of the ultimate film to water which is governed to a great extent by the hydrophilic nature of the emulsifying agent is also an important consideration Coupling these two considerations a new factor λ has been tentatively put forward to account for both stability and film character From the values for λ for the different samples (TABLE VII) it will be seen that sample (9) with a value of 8 7 appears to be the best vehicle for subsequent pigmentation

The work also throws light on the distribution of particles in terms of particle size Fischer and Harkins[21] report that in the case of paraffin oil emulsions the majority of particles had a diameter of about 1μ while in the case of benzene it was smaller King and Mukherjee[2] examining olive oil emulsions found that the maximum number of particles had a diameter of about 1μ and that the greatest contribution to the area was given by particles between 6 and 7μ In the case of our emulsions the maximum number of particles have been found distributed in the size range 0 5μ to 1 5μ and that the greatest volume of oil is dispersed in the range 6μ to 8μ

Thermodynamically emulsion instability can be defined as the rate of decrease of its interfacial area with time hence measurement of the extent of interface at various periods of time in the life of an emulsion should provide a quantitative measure of its properties Since the tendency to coalesce is more for particles having a small diameter ageing should decrease the number of particles of a small size and increase the bigger ones Therefore the degree of stability will be given by the change in the numerical distribution curve with time King and Mukherjee[2] have obtained numerical distribution curves for samples which were allowed to stand for several days From the curves which intersect near about 1μ it may be inferred that the tendency to coalesce is maximum for particles having a diameter of 1μ or less and minimum for larger particles The variation of interfacial area with time plotted for the same samples gives a straight line for most of their samples In the case of our experiments the numerical distribution curves show that the coalescence tendency is apparent up to a diameter of 5μ The variation of specific interfaces with time is almost a linear function for some of the samples (FIG 11)

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Studies in the Preparation of Viscose & Cellulose Acetate from the Pulps of Indigenous Cellulosic Materials

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Pulps from bamboos, reeds and bagasse, after a preliminary treatment with alkali, are suitable for the manufacture of viscose and acetate rayons

CERTAIN species of bamboo, e g Manwel (*Dendrocalamus strictus*), thorny bamboo (*Bambusa arundinacea*) and *Kamti*, and reeds bagasse, jute fibres, etc , yield high grade pulps if suitably processed[1,2] The pulps prepared from these approximate in chemical composition to rayon grade pulp[3] But the cellulose isolated from the different plant tissues, though chemically identical, differ from cotton cellulose both in reactivity and physical properties Their behaviour towards chemical reagents used in the viscose, acetate and other processes will be largely governed by physical properties

The present study relates to the behaviour of different cellulose preparations towards chemical reagents employed in the viscose and acetate processes and the optimum conditions for obtaining technically suitable products Also acetic acid esters have been prepared from the pulps to ascertain their suitability as raw materials for the manufacture of cellulose products

Experimental

Preparation of Viscose — Samples of pulps were reduced to the fibrous condition and cleaned by hand Viscose preparations obtained from them were examined for degree of ripening, viscosity, free alkali content and cellulose Finally they were converted into transparent films by Doree's method[3] The periods of ripening and of coagulation were noted in each case

Acetylation — The pulps were purified by steeping them in 8 per cent caustic soda solution (1 10) for 1·5 hr at room temperature , they were then washed, scoured, washed again and dried Before acetylation they were treated with glacial acetic acid (1 part cellulose and 1 part acetic acid), the quantity of acid so used being deducted from the acetylation mixture

The acetylation mixture consisted of glacial acetic acid acetic anhydride and a catalyst, viz sulphuric acid Sulphuric acid was used as catalyst on account of its cheapness The mixture was cooled to 10°C before adding the pulp and maintained at that level for about 15 min The temperature was allowed to rise gradually to 30° to 35°C till the dissolution was complete and a transparent, acrid-smelling, semi-fluid mass was obtained A portion of this mass when added to water gave a tough, leather-like precipitate, soluble in chloroform

Secondary Acetates — The hydrolysis of primary acetate to secondary acetate (acetone soluble) was brought about by dilute acetic acid in some cases, mixtures of glacial acetic acid and 10 per cent sulphuric acid were employed The hydrolysing agent was slowly added to the primary acetate solution under vigorous stirring the temperature being maintained below 40°C. The mixture was stored in an incubator at 50° to 55°C , until a test portion, when coagulated by the addition of water, gave a light fibrous precipitate soluble in acetone When the reaction was complete, the solution was poured into a large quantity of cold water The precipitate was washed free of acid, stabilized and dried The acetyl content of the preparation was determined by Eberstadt method[4]

Preparation of Films — The secondary acetate was dried in a vacuum desiccator and the dried material dissolved in acetone The solution was allowed to ripen for 24 hr and filtered through a sintered glass funnel The clear filtrate was spread over mercury to form films The films so obtained were dried at 100°C to remove the last traces of solvent. After cooling them in a desiccator,

TABLE I — PREPARATION OF PULP

RAW MATERIAL	ACID EMPLOYED	PRELIMINARY TREATMENT: Concentration: Solution %	PRELIMINARY TREATMENT: Concentration: On material %	PRELIMINARY TREATMENT: Temperature C.	PRELIMINARY TREATMENT: Duration	KIER TREATMENT: Pressure lb	KIER TREATMENT: Duration hr	KIER TREATMENT: Alkali concentration at beginning % on material	KIER TREATMENT: Ratio of alkali to bagasse	CHLORINE CONSUMED % ON MATERIAL	YIELD OF PULP %	ASH IN RAW MATERIAL, %	ASH IN PULP %	ALPHA CELLULOSE: In pulp %	ALPHA CELLULOSE: In raw material %
Bagasse	Sulphuric Hydrochloric	1 0 1 0	10 10	100	1 hr	20	2	NaOH — 15	1 20	3 15	3 95	3 39	0 31	8 84	28 94
							Intermediate bleach								
Reeds	Hydrochloric	0 5	5 0	Heated to boil	Soaked overnight	20	1	NaOH — 15	1 0	4 52	41 0	4 78	0 23	85 4	35 02
						0	2	NaOH — 15	1 15						
						60	6	NaOH — 15 Na_2S 5	1 15						
Manwel bamboo	do	0 5	5 0	do	do	90	2	NaOH 15	1 15	6 00	36 08	9 06	0 [illegible]8	85 89	30 96
						60	6	NaOH — 15 Na_2S — 5	1 15						
Kanis bamboo	do	0 5	5 0	do	do	90	2	NaOH — 15	1 15	4 05	40 18	5 5	0 96	86 10	34 59
						60	6	NaOH — 15 Na_2S — 5	1 15						
Thorny bamboo	do	0 5	5 0	do	do	20	2	NaOH — 15	1 15	4 98	38 04	2 12	0 6	8 08	33 19
						60	6	NaOH 15 Na_2S — 5	1 15						

strips of uniform width (15 mm) were cut out and their tensile strength measured in a Schopper machine

Discussion

The cooking and bleaching processes employed for preparing pulps and the compositions of the pulps are recorded in Table I The pulps have an α cellulose content of over 85 per cent and an ash content varying from 0 2 to 0 3 per cent

Experimental details relating to the preparation of viscose from pulps are given in Table II It will be seen that the weight of alkali cellulose in each case is 2 to 3 times the weight of the primary pulp Excess of caustic soda which would result in the formation of compounds like sodium thiocarbonate and affect the quality of viscose was avoided The alkali cellulose was matured for 4 days in all the cases except in the case of bagasse C viscose which was matured for 7 days

The consumption of carbon disulphide for xanthation varies with different pulps Bagasse pulp requires 48 81 to 73 21 per cent reed pulp 76 70 to 90 65 per cent Manwel *Kamli* and thorny bamboo pulps 92 1 to 95 16 90 18 to 98 50 and 96 56 to 99 00 per cent respectively The carbon disulphide required for standard American alpha pulp is 80 19 per cent on the weight of the pulp These figures are however somewhat higher than the actual requirements as an appreciable portion of the carbon disulphide was lost during the treatment Bagasse pulp required comparatively less carbon disulphide than either bamboo or reed pulps for complete xanthation This characteristic gives bagasse pulp an advantage as a source of viscose rayon

Viscose for spinning should have not only a definite viscosity but also a definite degree of ripening and its alkali and cellulose contents should lie within specified limits The viscose in each case was treated with 10 per cent acetic acid and the degree of ripening cellulose and alkali contents and viscosity were estimated (TABLE III) It will be observed that the viscose from bagasse pulp ripens within 6 to 10 days and sets within 14 to 19 days whereas viscose from reed pulp takes 5 to 7 days for ripening and 9 to 14 days for setting The corresponding periods for the American alpha pulp were 10 and 16 days respectively It

TABLE II — PREPARATION OF VISCOSE

PULP FROM	TREATMENT	WT OF PULP, gm	VOL OF 17 5% CAUSTIC SODA FOR MERCERIZATION, c.c	WT OF ALKALI CELLULOSE, gm	MATURATION PERIOD OF ALKALI CELLULOSE, days	AMOUNT OF CARBON DISULPHIDE REQD FOR XANTHATION, % on pulp	VOL OF THE SOLVENT (SOD HYDROXIDE SOD SULPHITE) USED, c c
Bagasse	A	37	558	108	4	69 73	130
	B	37	558	115	4	73 21	135
	C	37	558	112	7	48 81	100
	D	37	558	105	4	62 77	145
Reeds	A	18	280	45	4	86 23	60
	B	37	558	90	4	87 17	145
	C	37	558	96	4	90 65	145
	D	37	558	85	4	83 70	145
	E	37	558	80	4	76 70	145
Manwel bamboo	A	37	558	98	4	95 16	145
	B	37	558	106	4	92 10	160
Kamti bamboo	A	37	558	96	4	96 4	145
	B	37	558	110	4	98 5	160
	C	16	237	40	4	90 18	72
Thorny bamboo	A	37	558	100	4	96 56	145
	B	37	558	112	4	99 00	160
Regular alpha pulp (American)	A	37	558	108	4	80 19	145

TABLE III — ANALYSIS OF VISCOSE

MATERIAL	VISCOSE (Cf TABLE II)	RIPENING PERIOD, days	GELLING TIME AFTER PREPARATION days	DEGREE OF RIPENING IN C C OF 10% NH_4Cl	VISCOSITY TIME, sec *	FREE ALKALI % gm Na_4OH	CELLULOSE, %
Bagasse	A	7	15	8 9	29 2	7 87	7 65
	B	6	15	9 0	28 5	7 61	8 16
	C	7	14	7 7	25 8	7 98	8 10
	D	10	19	9 6	28 0	8 01	8 51
Reeds	A	5	9				
	B	7	11	9 8	58 6	8 12	7 50
	C	6	11	9 2	55 9	8 00	7 10
	D	7	13	8 9	59 5	7 73	7 59
	E	7	14	8 4	61 1	7 17	7 56
Manwel bamboo	A	5	11	9 4	80 1	8 10	8 40
	B	7	14	9 2	68 8	8 65	8 25
Kamti bamboo	A	5	12	9 1	82 4	7 88	8 30
	B	7	14	8 9	72 5	8 25	8 24
	C	7	14	8 2	70 8	8 07	8 00
Thorny bamboo	A	7	12	9 1	75 0	8 90	8 46
	B	6	11	9 65	79 2	9 01	8 10
Alpha pulp (American)	A	10	16	7 92	30 4	8 19	8 70

* Mean of 6 readings

TABLE IV — CHANGES IN VISCOSITY OF VISCOSE DURING RIPENING

Bagasse 'D'	Age of viscose hr	18 0	66 0	90	138 0	186 0	210	234 0	258	306	354
	Viscosity, sec *	15 3	16 6	18 2	19 4	23 8	26 20	28 0	29 6	33 9	38 7
Reeds 'E'	Age of viscose hr	18 0	45 0	69	117 0	141 0	168	216 0			
	Viscosity, sec *	30 4	29 6	35 3	44 7	51 1	61 07	68 5			
Manwel bamboo 'A'	Age of viscose hr	18 0	44 0	92	120	162 0	186	210 0			
	Viscosity, sec *	55 2	54 0	68 5	80 1	91 0	99 5	108 1			
Kamti bamboo 'A'	Age of viscose hr	16 0	40 0	72	98	125 0	183 0	208 0			
	Viscosity, sec *	58 4	55 0	66 2	72 0	82 4	98 0	110 4			
Thorny bamboo 'A'	Age of viscose, hr	20 0	44 0	68	95	144 0	170	194 0	220		
	Viscosity, sec *	52 1	50 6	55 2	61 4	70 0	75 0	81 1	86 8		

* Mean of 6 7 readings

may be further seen that with the same quantity, viz 145 c c of the solvent used to dissolve cellulose xanthate, bamboo pulps yield viscose of high viscosity expressed in sec., 68 80 to 82 40, while the viscose from reed pulp has a viscosity of 55·9 to 61 10 The viscose from bagasse pulp has a low viscosity, viz 25 80 to 29·20.

The rates of the changes of viscosity during the ripening of viscose were measured, and the results obtained are recorded in Table IV and are graphically represented in Fig 1. It will be observed that the viscosity of bagasse viscose increases slowly, while those of reed and bamboo viscose are fairly rapid Bagasse viscose has a longer coagulation period

The cellulose sheets prepared from the different viscoses were strong and transparent A slight milkiness was observed in the sheets and this is probably due to the presence of carbon disulphide vapour which could not be completely removed from the container in our experiments

The primary acetates were prepared under different experimental conditions In some cases, pulps were pre-swollen with glacial acetic acid with a view to increase the reactivity of cellulose and so minimize the time required for acetylation as in Mile's process[8] A preliminary treatment with sodium hydroxide was given in some cases to remove the pentosans, etc The experimental conditions and the nature of polyacetates obtained are recorded in Table V

It was observed during these experiments that the time required for the formation of triacetate soluble in chloroform is about

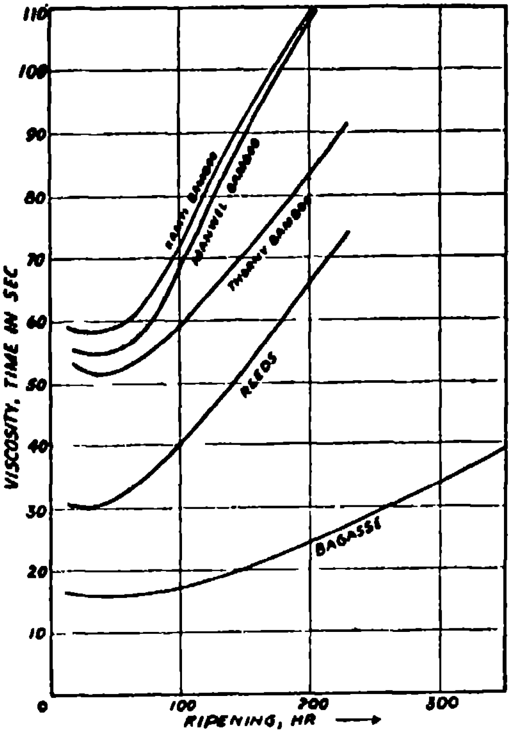

FIG 1—CHANGES IN THE VISCOSITY OF VISCOSE DURING RIPENING

TABLE V — PREPARATION OF PRIMARY ACETATES

PULP FROM	EXPERIMENT No	ACETYLATION MIXTURE PER GM OF CELLULOSE			TEMPERATURE OF THE REACTION, °C.	PERIOD OF REACTION, hr	NATURE OF THE POLYACETATE FORMED
		Acetic acid, glacial, c c.	Acetic anhydride, c c	Catalyst, viz sulphuric acid (com.), c.c.			
Reeds	1	3 75	3 75	0 025	10 30	0 25 6 00	Very viscous, somewhat transparent mass, pulp not completely dissolved
	2	3 75	3 75	0 05	10 30	0 25 6 00	Less viscous, more transparent with few undigested fibres, slightly coloured. Tough ppt soluble in chloroform with little alcohol
	3	3 75	3 75	0 075	10 30	0 25 6 00	Pulp was completely soluble giving transparent, viscous, slightly coloured mass, fairly tough ppt. soluble in chloroform with little alcohol
	4	3 75	3 75	0 10	10 30	0 25 5 00	Syrupy solution, slightly coloured, weak ppt soluble in chloroform with little alcohol
	5	3 75	3 75	0 025	10 30	0 25 20 00	Pulp completely soluble Fairly tough ppt. soluble in chloroform with little alcohol
	6	2 75 (Pre-treated with 1 c.c. of gl acetic acid)	3 75	0 05	10 30	0 25 4 00	Viscous, transparent mass Pulp completely soluble, slightly coloured, very tough ppt. readily soluble in chloroform with little alcohol
	7	2 75	3 75	0 06	18	20 00	Viscous, transparent mass with very few fibres unacted, tough ppt. soluble in chloroform with little alcohol

TABLE V — PREPARATION OF PRIMARY ACETATES — *contd.*

PULP FROM	EXPERIMENT No	ACETYLATION MIXTURE PER GM OF CELLULOSE			TEMPERATURE OF THE REACTION, °C	PERIOD OF REACTION, hr	NATURE OF THE POLYACETATE FORMED
		Acetic acid, glacial, c.c	Acetic anhydride c.c.	Catalyst viz sulphuric acid (com.), c.c.			
Reeds	8	2 75 (Mild bleach and pre treated with 1 c c of gl acetic acid)	3 75	0 05	10 30	0 25 4 50	Viscous, transparent, colourless mass Tough ppt soluble in chloroform with little alcohol
Pulp purified to remove hemicelluloses as described	9	3 75	3 75	0 05	10 30	0 25 8 00	Colourless, transparent, viscous mass with few undigested fibres Tough ppt. soluble in chloroform more easily in presence of little alcohol
	10	2 75 (Pre-swollen with 1 c c of gl acetic acid)	3 75	0 10	10 30	0 25 4 00	Colourless, transparent viscous mass pulp completely soluble, ppt not quite tough soluble in chloroform with little alcohol
	11	2 75	3 75	0 05	10 30 35	0 25 4 00 1 00	Colourless, transparent, syrupy solution with all the fibres dissolved Tough leather like ppt soluble in chloroform, more easily in presence of little alcohol
***Kanti* bamboo**	1	3 75	3 75	0 05	10 30	0 25 6 00	Very viscous, somewhat transparent, slightly coloured mass with few fibres undissolved
	2	3 75	3 75	0 05	10 30	0 25 8 00	Pulp completely soluble, viscous transparent but slightly coloured mass Tough ppt soluble in chloroform with little alcohol
	3	2 75 (Pre treated with 1 c.c of gl acetic acid)	3 75	0 05	10 30	0 25 5 00	Slightly coloured syrupy solution, very tough ppt. soluble in chloroform with little alcohol
	4	2 75	3 75	0 10	10 30	0 25 4 00	Slightly coloured syrupy solution Ppt weak soluble in chloroform with little alcohol
Pulp purified	5	3 75	3 75	0 05	10 30	0 25 6 00	Viscous, transparent mass with few fibres undissolved Tough ppt soluble in chloroform but not very freely
	6	2 75 (Pre swollen with 1 c c of gl acetic acid)	3 75	0 05	10 30 35	0 25 4 00 1 00	Colourless, transparent, syrupy solution Tough leather like ppt soluble freely in chloroform with little alcohol
Bagasse	1	3 75	3 75	0 025	10 30	0 25 4 00	Pasty mass with few fibres unacted
	2	3 75	3 75	0 05	10 30	0 25 6 00	Pulp completely dissolved Viscous, transparent mass with slight colouration Tough ppt soluble in chloroform in presence of alcohol
	3	3 75	3 75	0 10	10 30	0 25 4 00	Syrupy solution Ppt very weak, soluble in chloroform in presence of little alcohol
	4	2 75 (Pre treated with 1 c.c. of gl acetic acid)	3 75	0 05	10 30	0 25 4 00	Viscous solution, pulp completely dissolved tough ppt soluble in chloroform with little alcohol
	5	2 75	3 75	0 05	10 30 35	0 25 4 00 1 00	Almost colourless, transparent viscous solution Tough ppt soluble in chloroform more easily in presence of little alcohol
Alpha pulp (American)	1	2 75 (Pre-treated with 1 c.c of gl acetic acid)	3 75	0 05	10 30	0 25 4 00	Viscous, quite transparent clear solution Ppt tough, leather like, soluble in chloroform with little alcohol
	2	2 75	3 75	0 05	10 30 35	0 25 4 00 1 00	Clear, transparent, syrupy solution Tough ppt soluble in chloroform, more easily in presence of little alcohol

TABLE VI — HYDROLYSIS OF THE PRIMARY ACETATES

PRIMARY ACETATE (FROM TABLE II)	EXPERIMENT No	HYDROLYSING AGENT PER GM OF CELLULOSE	TEMPERATURE, °C	PERIOD OF HYDROLYSIS, hr	PERCENTAGE YIELD OF SECONDARY ACETATE	ACETYL CONTENT EXPRESSED AS ACETIC ACID, %	TENSILE STRENGTH OF THE FILMS, kg /mm.²	NATURE OF THE SECONDARY ACETATE
Reeds	1	25 c c gl acetic acid + 8 8 c c distilled water	55	12				White fibrous ppt hardens on drying not completely soluble in acetone Films — somewhat brittle and not quite clear
	2	6 c c gl acetic acid + 6 c c distilled water	55	12				White fibrous ppt not freely soluble in acetone Films — fairly strong but not quite clear and transparent
	3	do	30	18				White powdery ppt soluble in acetone Films — clear but brittle
	4	do	30	14				White powdery ppt soluble in acetone Films — very brittle
	5	3 c c gl acetic acid + 3 c.c of 10% sulphuric acid	55	14				White fibrous ppt soluble in acetone. Films — not very strong
	6	do	30	18	120 6	54 60	5 8	Light fibrous ppt easily soluble in acetone Films — quite clear, strong, transparent
	7	do	30	18	110 0	51 60	5 2	White fibrous ppt soluble in acetone Films — strong but not clear
	8	do	30	18	118 7	54 88	5 6	The fibrous precipitate easily soluble in acetone Films — quite clear, transparent and strong
	9	3 c c of gl acetic acid + 3 c c of 10% H_2SO_4	50	12	128 4	50 82	5 6	Ppt fibrous but hard, not very freely soluble in acetone Films — quite strong but not quite clear and transparent
	10	1 c c of gl acetic acid + 1 c c of distilled water	50	12	130 8	54 60	5 8	Ppt fibrous and light, soluble in acetone Films — clear, transparent but somewhat brittle
	11	do	50	12	131 5	55 12	6 1	Ppt fibrous, light, freely soluble in acetone Films — very clear, transparent and strong
Kamti **bamboo**	1	3 c c of gl acetic acid + 3 c c of 10% sulphuric acid	30	24				White fibrous ppt hardens on drying Not easily soluble in acetone Films — brittle
	2	do	30	18	118 8	52 78	5 1	White fibrous ppt freely soluble in acetone Films — quite clear, strong, transparent
	3	do	30	18	126 3	55 20	5 6	do
	4	do	30	18				White fibrous ppt soluble in acetone Films — quite clear but brittle
	5	1 c c of gl acetic acid + 1 c c of distilled water	50	12	130 80	49 92	5 0	Ppt fibrous but not quite light and not freely soluble in acetone Films — fairly strong but not clear
	6	do	50	12	134 10	55 45	5 8	Ppt quite light and fibrous, easily soluble in acetone Films — strong and transparent
Bagasse	1	12 c c of gl acetic acid + 12 c c of distilled water	55	12				Fibrous ppt which became powdery on drying Not freely soluble in acetone Films — brittle
	2	3 c c of gl acetic acid + 3 c.c of 10% sulphuric acid	30	17	120 50	54 16	5 4	White fibrous ppt soluble in acetone Films — transparent, clear and strong

TABLE VI—HYDROLYSIS OF THE PRIMARY ACETATES—*contd.*

PRIMARY ACETATE (FROM TABLE II)	EXPERIMENT No	HYDROLYSING AGENT PER GM OF CELLULOSE	TEMPERATURE, °C	PERIOD OF HYDROLYSIS, hr	PERCENTAGE YIELD OF SECONDARY ACETATE	ACETYL CONTENT EXPRESSED AS ACETIC ACID, %	TENSILE STRENGTH OF THE FILMS, kg /mm²	NATURE OF THE SECONDARY ACETATE
Bagasse	3	3 c.c of gl. acetic acid + 3 c.c. of 10% sulphuric acid	30	17				White powdery ppt soluble in acetone Films — very brittle
	4	do	30	17	122 0	53 88	5 4	White fibrous ppt freely soluble in acetone Films - glossy, transparent and strong
	5	1 c c of gl acetic acid + 1 c c of distilled water	50	14	128 6	54 18	5 6	Light fibrous ppt soluble in acetone Films — strong and transparent
Alpha pulp (American)	1	3 c c of gl acetic acid + 3 c c of 10% sulphuric acid	30	18	142 7	55 20	6 4	White fibrous ppt freely soluble in acetone transparent and strong films
	2	1 c c of gl acetic acid + 1 c c of distilled water	50	12	143 5	55 25	6 5	Light fibrous ppt readily soluble in acetone Films — very clear, transparent and strong

20 hr at 18°C and 6 to 8 hr at 30°C The period could be reduced to about 4 hr by swelling the cellulose with acetic acid before actual acetylation The reaction period decreases with increase in the amount of sulphuric acid, quantities exceeding 10 per cent of the weight of the pulp had a detrimental effect on the final product

The triacetate was slightly coloured except in the case of reed pulp (treatment 8, TABLE V) which was given a mild bleach prior to acetylation Transparent and colourless masses were obtained also by treatments 9, 10 and 11 (TABLE V)

The results of experiments on the hydrolysis of triacetate are recorded in Table VI Acetone-soluble products were obtained by hydrolysing the triacetate with 50 per cent acetic acid at 50°C for 12 to 16 hr The secondary acetates were obtained as light fibrous precipitates (TABLE VI, treatments 10 and 11) The percentage yield of secondary acetate from reed pulp is 131 5 per cent, from *Kamti* bamboo, 134 1 per cent, from bagasse 128 6 per cent The yield in the case of alpha pulp is 143 5 per cent The acetyl content of all the acetates is 55 0 per cent The tensile strengths of films prepared from the acetates are as follows reed pulp, 6 1 kg /sq mm , *Kamti* bamboo, 5 8 kg /sq mm , bagasse pulp, 5 6 kg /sq mm , alpha pulp, 6 5 kg /sq mm

These data clearly indicate that pulps from reeds, bamboo and bagasse, after a preliminary treatment with caustic soda, are suitable for use in the rayon industry

The investigations were conducted with equipment ordinarily available in a laboratory Better results could be obtained with specialized equipment for stirring and beating pulps, for de-aeration and filtration of viscose and for casting films The data recorded here should be regarded as indicative of the possibilities Trials on a pilot-plant scale are necessary to enable definite conclusions to be drawn on the suitability of these raw materials for large-scale exploitation

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Long Chain Aliphatic Nitriles from Methyl Esters of Fatty Acids

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A method is described for the preparation of nitriles of long chain fatty acids by the action of gaseous ammonia on the methyl esters Good yields (60 65 per cent) of the nitriles are obtained without employing a catalyst A preferential saponification method for the estimation of the esters in the presence of nitriles has been standardized

LONG chain fatty acid nitriles of the type of R CN are used as plasticizers insect repellents and as intermediates in the preparation of a host of cationic detergents They are prepared by the ammonolysis of fats and fatty acids Two procedures are described in literature In the first liquid ammonia is made to react with fatty acids or oils in the presence of a catalyst like ammonium chloride in a Carius tube or a steel autoclave[1 2] The pressures developed by liquid ammonia at temperatures which sometimes range up to 165°C are so high (at 132°C the pressure is 1635 lb /sq in) that it requires specially constructed vessels and careful handling The amides so formed (reported to have been obtained in 90 per cent yield) can then be thermally decomposed to yield the nitriles This two stage preparation has now been superseded by one stage simpler methods[3] wherein ammonia gas reacts with fats or fatty acids at temperatures ranging from 330° to 360°C

By passing gaseous ammonia through liquid stearic acid at 330°C Ralston *et al*[4 5] obtained the nitriles in 84-85 per cent yields Other patents and reported procedures are essentially modifications of the methods mentioned above Reutenauer and Paquot[6 7] prepared stearonitrile and palmitonitrile and succeeded in converting unsaturated acids like oleic and erucic to their respective nitriles (yields 75 per cent and over) by adopting a method similar to that of Ralston and co-workers The method has also been adapted to prepare nitriles from other fats and oils[8] but the product obtained is a complex mixture difficult to separate and the method is not suited for the preparation of homogeneous products

The vapour phase reaction between fatty acid esters and ammonia in the presence of catalysts like Japanese acid clay[9 10] were confined to the preparation of nitriles from low molecular weight acids like acetic and propionic acids Two patents[11 12] report the preparation of nitriles of fatty acids (containing more than 8 carbon atoms in the chain) by the catalytic vapour phase reaction method

In the present communication the possibility of converting the liquid methyl esters of fatty acids into the corresponding nitriles by direct interaction with ammonia gas has been investigated The esters are prepared as intermediates in the purification of fatty acids by fractional distillation of fatty acid esters

Experimental

A mixture of 94 per cent methyl stearate and 6 per cent methyl palmitate is used for ammoniation It is a white waxy solid m p 36 5° 37 5°C free from acid and has an ester value of 187 190 5 The boiling range of the mixture at 1 mm pressure is 152 55°C

30 gm of ester mixture and the catalyst are taken in a 500 c c round bottom three necked flask fitted with a lead in tube for gaseous ammonia a thermomete and a 0 5" bore glass tube (70 cm) bent in the form of a V to serve as a reflux Ammonia is passed at the rate of 3 4 bubbles per second The bubbling is started when the temperature of the contents of the flask reaches 150°C The temperature is raised to 345° 50°C and maintained for about 5½ 6 hr after which the product is cooled in a stream of ammonia transferred to a 100 c c Claissen flask and distilled

Analysis of the Product

The percentage of nitrile in the product is estimated by the Kjeldahl's method The product undergoes easy digestion and the values are reproducible (experimental error 2-3 per cent) There is little chance of any amide distilling over at 340°-58°C, since the decomposition of the amide commences at temperatures as low as 250°C

The percentage of free fatty acid in the product is determined by the estimation of acid value by the standard method and expressed as stearic acid.

Some unreacted ester may also be present in the distillate Since both the nitrile and the ester are neutral bodies, a chemical separation and estimation of the residual unreacted ester is difficult Fractionation under vacuum distillation can be employed, but it is time-consuming and not quite quantitative A method of differential hydrolysis by alcoholic potash of definite strength has been successfully adopted for the analysis of such a mixture and found to give consistent results Preliminary experiments with pure nitrile and different concentrations of alcoholic potash have shown that the lower limit of KOH concentration, at which the nitrile begins to hydrolyse, is about 1 N (TABLE I) Hydrolysis with mixtures of known compositions of nitriles and ester, for 1 hr with 0 37 N alkali, shows that while the ester undergoes complete hydrolysis, the nitrile is unaffected (TABLE II)

TABLE I

Strength of alkali, N	Nitrile hydrolysed in 1 hr, %
0 23	0 0
1 26	1 5
2 87	84 90
3 73	95 and above

TABLE II

Ester in the ester nitrile mixture, %	Weight of ester, gm	Weight of ester calculated from saponification value, gm	Error, %
39 5	0 2902	0 295	1 8
39 7	0 3040	0 310	2 0
41 5	0 3126	0 318	1 7
52 0	0 4380	0 435	−0 7
55 5	0 9990	0 997	−0 2
61 5	0 9450	0 948	−0 2

The results of ammoniation of the ester mixture employing different catalysts are recorded in Table III Ammoniation in the liquid phase, under reflux, proceeds smoothly Good overall yields (60-65 per cent) of the nitrile are obtained in 5½-6 hr at a temperature of 345°-50°C When ammoniation is carried out at pressures lower than the atmospheric pressure and temperatures lower than 300°C, it is found that the yield of nitrile is very small At 250°C and 50 cm pressure, there is no nitrile formation

TABLE III

(30 *gm. of ester mixture, time of reaction* 5 5 6 *hr*)

Yield of the distillate, gm	Catalyst used	Stearo-nitrile by Kjeldahl method, %	Free stearic acid from acid value, %	Un reacted ester from ester value, %
22		76 77	7 2	15 6
21	3 gm B D H Fullers' earth	76 77	2 5	20 4
17	3 gm of 40 mesh Al_2O_3	67 5	3 2	26 5
18	1 gm of tungstic acid	61 9	3 0	31 2
22	3 gm of glass wool	56 0	3 3	36 1
20	3 gm of silica gel	53 8	17 6	24 2
21	10 gm of silica gel	77 3	6 3	15 8
21	Silica gel from above, re used	78 6	6 3	14 2
20	Silica gel (3 gm) coated with P_2O_5	60 2	1 7	34 3

Discussion

The nitrile formation apparently takes place in two stages

(I) $RCOOCH_3+NH_3 \rightarrow RCONH_2+CH_3OH$

(II) $RCONH_2 \rightarrow RCN + H_2O$

The mechanism of reaction II is not very clear If it was direct dehydration, the residue must be only nitrile and unreacted ester There is, however, an appreciable quantity of free acid found in the product (TABLE III) This can be accounted for if the water generated in reaction II can hydrolyse some of the amide formed in reaction I But under the conditions of reaction there is hardly any likelihood of hydrolysis of the amide in the absence of high pressures The presence of free acid was also observed by Ralston in the decomposition products of stearamide This can be explained on the basis of the "disproportionation" reaction (reaction III) which

Ralston has postulated as the main step in the ammoniation of fats and fatty acids

(III) $2\ RCO\ NH_2 \rightarrow RCN + RCO\ ONH_4$

The ammonia soap formed in this reaction should decompose readily, either to RCO OH and NH_3, as shown in reaction IV, or to $RCO\ NH_2$ and H_2O as shown in reaction V Though there is excess ammonia in the system, the reaction IV will not be retarded as it is carried out only at atmospheric pressure Ammonia salts decompose readily except when high back-pressures are developed

(IV) $RCO\ ONH_4 \rightleftarrows RCO\ OH + NH_3$

(V) $RCO\ ONH_4 \rightleftarrows RCO\ NH_2 + H_2O$

There is an appreciable degree of dissociation taking place as per reaction IV and this accounts for the presence of free acid

It is to be noted that when free fatty acids are used for ammoniation, the formation and volatilization of ammonia soap according to $RCO\ OH + NH_3 \rightarrow RCO\ ONH_4$ is generally rapid and chokes the condenser Packed columns, heated electrically, have, therefore, been used for reflux With fatty acid ester as the starting material, the reaction is so smooth that a 0 5″ dia and 2′-2 5′ long glass tube serves efficiently for refluxing purposes Also good yields of nitriles are obtained without the use of any catalyst Since methyl esters of fatty acids are usually prepared in the process of purification of fatty acids, the possibility of direct conversion of the ester into nitriles is of interest

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Letters to the Editor

INTERFERENCE BY CERTAIN SUBSTANCES PRESENT IN RAGI (*ELEUCINE CORACANA*) IN THE DETERMINATION OF THIAMINE BY THE THIOCHROME METHOD

Bhagvat and Devi[1] reported that when thiamine was added to suspensions of raw or autoclaved ragi in acetate buffer (*p*H 5 6) and incubated overnight at 37°C, only a small portion of the added thiamine was found in the aqueous extract as determined by the thiochrome method and biological assays On eluting the ragi residue with various common elutrients, they could not detect any thiamine in the eluates They also observed that the recovery of thiamine (by the thiochrome method), added to water or chloroform-water extracts of ragi, was low (10-30 per cent) On the basis of the above findings, they concluded that ragi and ragi extracts contained an anti-thiamine factor which destroyed a greater part of the added thiamine

Ragi is one of the important cereals consumed extensively in certain parts of South India and the Deccan Plateau, particularly in Mysore State The investigations of Bhagvat and Devi (loc cit) would suggest that the anti-thiamine factor present in ragi is likely to destroy not only the thiamine present in ragi but also that present in other foods consumed along with ragi So far as is known, beriberi has not been reported to occur among poor ragi eaters, even though this disease is known to occur among poor rice eaters in Northern Circars in the Madras Province This would suggest that the thiamine present in ragi and other foods consumed along with it is probably available *in vivo* However, in view of the findings of Bhagvat and Devi (loc. cit), it was felt desirable to investigate further the nature of the anti-thiamine factor in ragi

The thiamine content of the sample of ragi (variety H 22) used in the present investigation was determined by the thiochrome method described previously by one of the authors (Swaminathan[2]) with slight modifications and also by the rat-growth method according to Bhagvat and Devi[1] The results were as follows by thiochrome method, 3 8 µgm /gm , by rat-growth method, 3 6 µgm /gm , thus showing that there was close agreement between the values obtained by the two methods When thiamine (100 µgm) was added to ragi (10 gm), the recovery of added thiamine by the thiochrome method was about 80 per cent, the percentage of recovery obtained being higher than that (20 to 30 per cent) reported by Bhagvat[3]

Next a chloroform-water (C W) extract of ragi was prepared according to Bhagvat and Devi (loc cit) The recovery of thiamine added to the C W extract was found to be low, ranging from 20 to 25 per cent Bhagvat and Devi (loc cit) also reported very low recoveries (5 7 per cent) It was found, however, that on clarification of the extract with basic lead acetate according to Swaminathan[2], the recoveries were 93 to 95 per cent (TABLE I)

The results showed that there was no destruction of the added thiamine and that almost the entire quantity could be recovered after clarification of the mixture with basic lead acetate which apparently removed the interfering substances present in the extract

The interfering materials were separated from the lead precipitate and their effect on the thiochrome reaction was further studied To 200 c c of C W extract of ragi, 40 c c of 10 per cent basic lead acetate solution were added The precipitate was separated on the centrifuge and suspended in 98 c c of water It was then decomposed by the addition of 2 c c of 10 N H_2SO_4 The precipitated lead sulphate was removed on the centrifuge The clear supernatant liquid was adjusted to *p*H 5 6 Varying quantities of this liquid (A) were then added to known quantities of thiamine and the estimations carried out in the usual manner (TABLE II)

The results showed that (1) the addition of a solution containing the interfering

TABLE I — THE EFFECT OF CLARIFYING THE CHLOROFORM-WATER EXTRACT OF RAGI WITH BASIC LEAD ACETATE ON THE RECOVERY OF ADDED THIAMINE

SERIAL No	TREATMENT	RECOVERY OF THIAMINE ADDED TO THE CHLOROFORM WATER EXTRACT OF RAGI, %
1	25 µgm of thiamine added to 25 c c of C W extract of ragi	25
2	25 µgm of thiamine added to 25 c.c of C W extract of ragi and the mixture clarified by treatment with basic lead acetate, excess of lead being removed as lead sulphate	95
3	25 µ gm of thiamine added to 25 c c of C W extract of ragi, the mixture allowed to stand for 2 hr at room temperature and then clarified by the addition of basic lead acetate	93

TABLE II — THE EFFECT OF ADDING VARYING QUANTITIES OF A SOLUTION CONTAINING THE INTERFERING SUBSTANCES ON THE THIOCHROME REACTION

SERIAL No	TREATMENT	RECOVERY OF ADDED THIAMINE, %
1	5 µgm thiamine plus 10 0 c c of water (control)	100
2	5 µgm thiamine plus 0 25 c c of sol A (0 05 gm ragi) plus 9 75 c c of water	80
3	5 µgm thiamine plus 0 5 c c of sol A (0 1 gm ragi) plus 9 5 c c of water	60
4	5 µgm thiamine plus 1 0 c c of sol. A (0 2 gm ragi) plus 9 0 c c of water	50
5	5 µgm thiamine plus 2 0 c c of sol A (0 4 gm ragi) plus 8 0 c c of water	38
6	5 µgm thiamine plus 5 0 c c of sol A (1 0 gm of ragi) plus 5 c c of water	26
7	5 µgm thiamine plus 10 0 c c of sol A (2 0 gm ragi)	19
8	10 0 c c of sol A oxidized with alkaline ferricyanide and extracted with 15 c c of isobutyl alcohol containing thiochrome from 5 µgm thiamine	90
9	15 0 c c of sol A plus 15 c c of acetate buffer (*p*H 5 6) plus 30 µgm. thiamine (incubated at 37°C for 24 hr)	33
10	Same as (9) above but after clarification of the mixture by addition of basic lead acetate and removing excess of lead as lead sulphate	86

materials in increasing quantities progressively decreased the percentage recovery of added thiamine, and (2) the interfering substances did not destroy the thiamine added even when kept in contact for 24 hr at 37°C as shown by the high recovery of added thiamine obtained, after removal of the interfering materials by treatment with basic lead acetate

Bhagvat and Devi (loc cit) reported that the recovery of thiamine added to suspensions of autoclaved or raw ragi in acetate buffer was low (5 to 10 per cent) In view of the foregoing observations and with a view to determine whether the added thiamine was actually destroyed under such conditions, the experiments were repeated according to Bhagvat and Devi (loc cit) with the following modifications (1) the aqueous extracts of ragi were clarified by treatment with basic lead acetate according to Swaminathan[2] before estimating the thiamine present by the thiochrome method, and (2) the residue of ragi left after separating the aqueous extracts was digested with pepsin for 24 hr and the peptic digests were analysed for thiamine content after being clarified with basic lead acetate The results obtained are given in Table III

TABLE III — RECOVERY OF THIAMINE ADDED TO A SUSPENSION OF AUTOCLAVED OR RAW RAGI IN ACETATE BUFFER

	THIAMINE ADDED TO SUSPENSION OF AUTOCLAVED RAGI (5 GM) IN ACETATE BUFFER, µgm	THIAMINE GROUND UP WITH 2 5 GM RAGI POWDER & SUSPENDED IN ACETATE BUFFER, µgm
(1) Thiamine added to the sample	1000	1000
(2) Thiamine found in the extracts obtained after incubating the mixture in acetate buffer at 37°C for 18 hr	50	266
(3) Thiamine found in the residue from (2) above after digestion with pepsin at 37°C for 24 hr	720	550
(4) Thiamine found in the residue from (3) above after further digestion with pepsin at 37°C. for 24 hr	50	not determined
Total thiamine recovered	820 µgm (82%)	816 µgm (82%)

The present investigation has shown that (1) aqueous or chloroform-water extract of ragi contains interfering substances which can be removed by treatment with basic lead acetate, and (2) the solid material of ragi retains tenaciously a greater part of the added thiamine The above findings may explain the apparent loss of thiamine added to ragi reported by Bhagvat and Devi (loc cit) The thiamine retained by the solid material of ragi can be recovered by digesting the material with pepsin The recovery of thiamine added to ragi was about 82 per cent. Considering that the error by the thiochrome method (using the fluorimeter) is usually of the order of 5 per cent and that the recovery of thiamine added to most common biological materials ranges from 70 to 95 per cent, it may be inferred that almost the whole of the thiamine added to ragi was recovered by following the above procedure The above results would indicate that there is no appreciable destruction of thiamine added to ragi This is further supported by biological assay, the results of which are in close agreement with those obtained by the modified thiochrome method[3]

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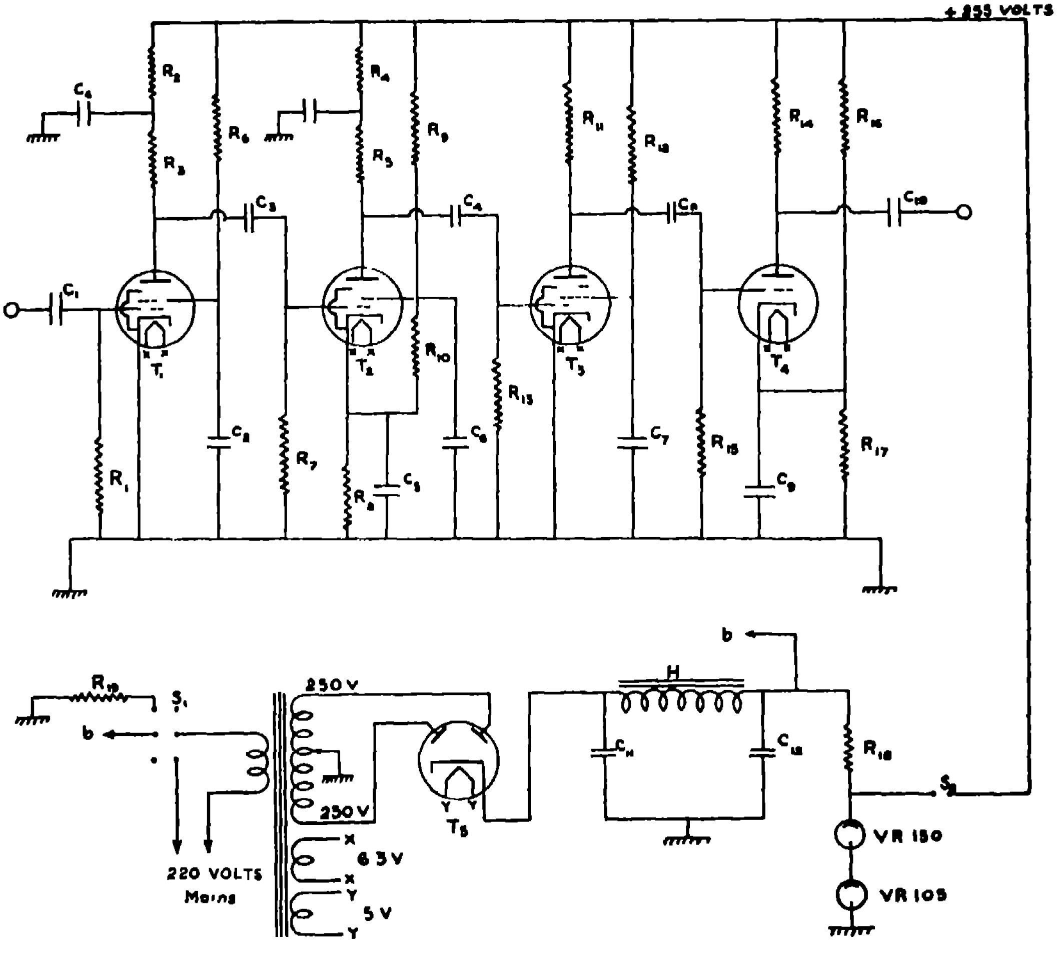
AMPLIFIERS OF PULSES FROM ELECTRICAL COUNTERS OR IONIZATION CHAMBERS OR ELECTRON MULTIPLIERS

THE OUTPUT PULSES OF ELECTRICAL COUNTERS or electron multipliers which are usually of the order of 10^{-2} to 10^{-3} volts are not adequately effective so as to render the electronically operated mechanical counter or recorder operative Hence these pulses with such a low amplitude are incapable of being either detected effectively or recorded or counted It is, therefore, essential to provide electrical counters or electron multipliers or ionization chambers with suitable amplifiers to amplify and equalize the amplitude of the pulses so as to secure the registration of the impulse frequency with high degree of accuracy The operational principle of this pulse amplifier, shown in Fig. 1, like that of the linear amplifier of Wynn-Williams and Ward[1], is in a way similar to that of an audio frequency amplifier

The amplifier (Fig 1) employs three stages of resistance-capacity coupling It accomplishes the greater part of the amplification with the first two pentode tubes The highest resolution is obtained between the second and the third tubes and in the output of the third tube

The grid of the second tube is kept positive The impulses coming from the first stage of the amplifier are of sufficient amplitude and positive in nature above the level of the positive grid bias The output of the second tube will then be only the genuine negative impulses without spurious signals such as those arising out of the thermal noise in the resistance of the grid circuit, short noise from grid current in the R-C network and the zero noise of the tube

In this circuit, shown in Fig 1, resistance-capacity coupling of a fairly large time constant has been employed between the



$T_1 = T_2 = T_3 = 6SJ7$, T_4 - 6C5, T_5 - 5Y3 $R_1 - 1M\Omega$, R_2 $R_3 - R_4 - R_5 - R_{11} - R_{14}$ - 50K, R_6 $R_{12} = 40K$, $R_7 = 20K$, $R_8 = R_{13} = R_{15}$ 10K, $R_9 - R_{16} = R_{17} = 1M\Omega$, R_{10} - 75K $R_{18} - 2500\Omega$ (10W), R_{19} 25000Ω (10W), C_1 = 0001μF, $C_2 = C_6 - C_7$ = 1μF, C_4 - 00001μF, $C_5 = C_9$ - 50μF, $C_8 - C_{10}$ = 001μF, $C_{11} = C_{12} = 16$μF (Electrolytic), H = 25 Henry

Fig 1 — Pulse amplifier

first and the second tubes so as to obtain equalization of the pulses in the second stage which is important from the point of view of the short time constant of the resistance-capacity coupling between the second and the third tubes and between the third tube to the output stage The levelling of the impulses is very advantageous for either effecting reliable operation of the electronically operating mechanical counter or for easily bringing the accompanying scaling system into working order so as to accomplish a very reliable scaling of the impulse frequency

The output of an electrical tube-counter, whose electrode is at positive potential and the tube at ground potential, when applied to the amplifier, the amplifier at the end of its third stage of R-C coupling, transmits pulses of positive potential These positive pulses may directly be transmitted to a thyratron operated mechanical counter for recording the counter impulse frequency The mechanical counter, however, is unable to cope with the high rate of impulse frequency To surmount this difficulty, the impulses are scaled down by means of a scaler to a rate that is capable of being recorded without appreciable error by electronically operated mechanical counter

The scaler which is designed for incorporating in this circuit, however, is ineffective to the pulses of positive potential transmitted from the third stage of the amplifier Hence a suitable triode circuit is incorporated and the output pulses of the third stage of the amplifier are applied to this triode tube circuit in order to amplify and change the pulses to those of negative potential for transmitting them to the scaler for operation With proper selection of the time constant of the coupling between the second and third stages of the amplifier, and the amplification and the resolution of the triode tube circuit, the amplitude, form and the time constant of the input pulses transmitted to the scaling system can be moulded with greater flexibility and degree of freedom to a magnitude and form necessary for easily accomplishing scaling action

The amplifier is simple in construction and easy to operate It requires only one stabilized power supply for its operation It needs no batteries or additional power supply for grid bias It has been in use for the last six months and has been found stable, reliable and efficient with adequate resolution not far exceeding the dead time of the counter

In concluding this note the authors express their deep gratitude to Dr Swami Jnanananda for kindly suggesting the development of this unit and guiding them throughout the course of the work

A Sagar
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S K Suri
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National Physical Laboratory of India
New Delhi
June 21, 1950

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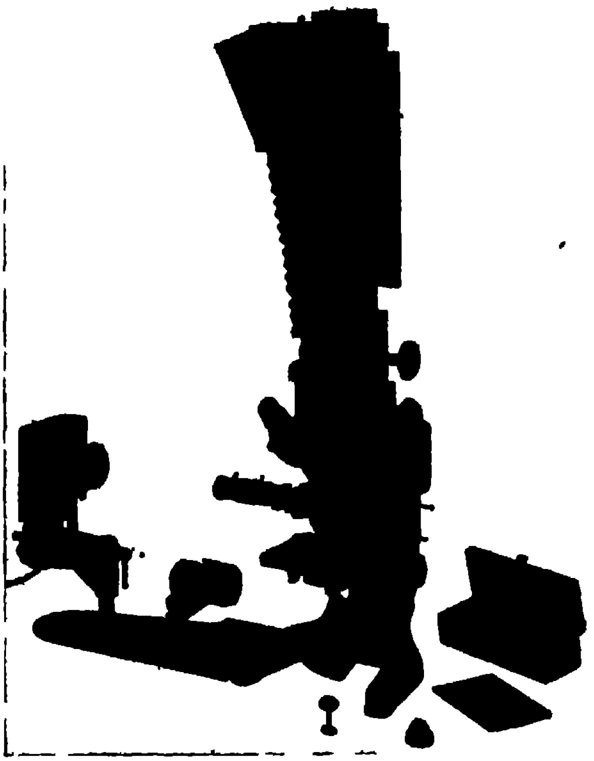

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Ultrasonic Studies in Electrolytes: Part I—Alkali Halides

BH KRISHNAMURTY
Department of Physics, Andhra University, Waltair

Ultrasonic methods have been employed for studying the influence of concentration on the viscosity and surface tension of aqueous solutions of 4 alkali halides, KI, KBr, KF and NaF The viscosity-concentration curves show a maximum at 0·3 mol. concn. in all the 4 cases The surface tension increases with concn. in all the cases. In the range of concns studied, the following empirical relationships hold good: (1) $\eta = 2{\cdot}0\times10^{8}\beta$ and (2) $T = 1{\cdot}2\times10^{-4}\rho v^{3/2}$, where β represents adiabatic compressibility; ρ, density; and v, ultrasonic velocity

THE addition of an electrolyte to water is found to influence some of its molecular properties like the adiabatic and apparent molar compressibilities, viscosity, surface tension, etc Investigations relating to the variation of these properties with different concentrations of the electrolyte, especially utilizing ultrasonic methods, have been few in number, and do not give any definite idea of the nature and extent of influence, especially in regard to the latter two. The variation of the adiabatic compressibility was, however, found to conform to a relation of the type $\beta = \beta_0 + Ac + Bc^{3/2}$, deduced by Bachem[1], where β is the adiabatic compressibility of the solution at the molar concentration c, β_0 is that of water, A and B are constants, A being large and negative and B small and positive. According to this equation, therefore, the adiabatic compressibility decreases continuously with increasing concentration and remains always below that of water. An explanation for this lowering of the adiabatic compressibility can be sought in Debye-Huckel theory. The electrostatic field around each ion in solution exerts a large electrostatic pressure which, just like an enormous external pressure, lowers the compressibility

Similarly, the apparent molar compressibility φ (which is a function of β) of the electrolytes is found to follow the linear relation $\varphi = a + b\sqrt{c}$, obtained by Gucker[2], where a and b are constants, and $a = \varphi_0$, the apparent molar compressibility at infinite dilution (i e $c = 0$) Gucker calculated the values of φ for many electrolytes using the compressibility data obtained by Mair and Lanmann[3], Perman and Urry[4] and others by piezometer measurements He had shown that the apparent molar compressibility follows the linear relation set forth above Also Falkenhagen and Bachem[5], and Bachem[6] independently studying solutions of NaCl, KBr, $BaCl_2$, Na_2Co_3, $MgSO_4$, etc, by ultrasonic methods had shown that Gucker's relationship is followed by all the electrolytes Ultrasonic velocity measurements in solutions of electrolytes were carried out by Hubbard and Loomis[7], and Szalay[8], and they obtained linear graphs between velocity and concentration

Some of the alkali halides like KI and NaI and KNO_3, however, show a departure from such a linear relationship, especially at lower concentrations

In case of viscosity and surface tension, no such simple relationships have been proposed

In the present investigation, 4 alkali halides, KI, KBr, KF and NaF, have been chosen to test the linear relationships in these cases, especially at close concentrations in the low concentration range (up to 0·5 mol) where departures have been reported for some electrolytes Under the same conditions of temperature and atmospheric pressure the viscosity and surface tension determinations have also been made A correlative study of these different properties may give a better insight into the cause and extent of their variation

Also for each electrolyte at all concentrations the values of

$$\frac{\alpha_r}{N^2}$$

where α_r is the absorption coefficient of sound at the frequency N have been calculated using Stokes[10] formula

$$\frac{\alpha_r}{N^2} = \frac{8}{3}\,\frac{\pi^2\eta}{v^3\rho}$$

where v ρ η are the ultrasonic velocity, density and viscosity at the corresponding concentration

Experimental

The ultrasonic velocities have been determined by the well known Debye Sears[11] arrangement for the diffraction of light by ultrasonics The densities are determined by a sensitive Bunge balance and the adiabatic compressibility is calculated using the equation

$$\beta = \frac{1}{v^2\rho}$$

The apparent molar compressibility is calculated using the relationship

$$\varphi = \frac{1000\beta}{c} - \frac{\beta_1}{d_1}\left\{\frac{1000d}{c} - M_2\right\}$$

where β is the adiabatic compressibility at the molar concentration c β_1 and d_1 are adiabatic compressibility and density of water and M_2 is the molecular weight of the electrolyte

The viscosity η is determined by the syphon method The surface tension T is determined by observing the rise in a capillary tube Curves representing the relation between (1) β and c (2) φ and $\sqrt{c}$, (3) η and c (4) T and c and (5) $\frac{\alpha_r}{N^2}$ and c have been drawn Empirical relationships between (1) η and β and (2) T v and ρ have been proposed The results are given in Table I and also graphically represented in Figs 1-5.

Accuracy of Results — The density determinations are accurate up to one part in 1000 The accuracy of the fringe width measurements is estimated as 2 parts in 1000 The wavemeter (Philips heterodyne type) used to fix the frequency of the oscillator measures with an accuracy of 0 2 per cent Hence the estimated accuracy of the velocity determinations is about 2

TABLE I

c mol /lit	ρ	v meters	$\beta\times10^{\prime}$	$\varphi\times10^{\prime}$	$\eta-10^{\prime}$	$\frac{\alpha_r}{N^2}\times10^{\prime\prime}$	$\eta/\beta-10^{\prime}$	T	$\frac{T}{\rho v^2}\times10^{\prime}$
KI Temp 31°C									
0 1	1 012	1538	42 29	−17 2	8 230	5 89	2 0	71 61	1 2
0 2	1 022	1528	42 38	− 6 7	8 578	6 20	2 0	73 02	1 2
0 3	1 036	1517	42 45	− 3 7	8 326	6 06	2 0	74 54	1 2
0 4	1 046	1526	41 60	− 4 1	8 104	5 75	2 0	74 16	1 2
0 5	1 059	1523	41 23	− 3 9	8 021	5 65	2 0	74 85	1 2
1 0	1 114	1541	38 25	− 3 6	7 416	4 79	1 9	75 15	1 1
KBr Temp 29 C									
0 1	1 00[illegible]	1549	41 96	−21 5	8 079	5 896	1 9	73 98	1 2
0 2	1 015	1534	42 37	− 8 3	8 364	6 018	2 0	75 77	1 2
0 3	1 023	1526	42 47	− 4 6	8 874	6 427	2 1		
0 4	1 029	1532	41 88	− 4 3	8 925	6 348	2 1	77 59	1 2
0 5	1 040	1545	40 71	− 5 7	8 572	6 878	2 1	77 41	1 2
1 0	1 078	1547	39 18	− 3 4	8 668	5 711	2 2	77 23	1 2
KF Temp 28 C									
0 1	1 002	1541	42 50	−18 6	8 470	6 078	2 0	72 07	1 2
0 2	1 005	1523	43 40	− 4 2	8 952	6 640	2 1	75 04	1 3
0 3	1 009	1519	43 46	− 2 2	8 872	6 607	2 0	75 18	1 3
0 4	1 014	1549	41 57	− 6 4	8 913	6 226	2 1	76 93	1 2
0 5	1 018	1569	40 87	− 7 2	9 069	6 074	2 2	76 60	1 2
1 0	1 037	1572	39 50	− 4 1	9 625	6 292	2 4	75 95	1 2
NaF Temp 28°C									
0 1	1 003	1533	42 64	−18 2	8 624	6 222	2 0	75 48	1 3
0 2	1 008	1526	43 06	− 7 2	8 760	6 440	2 0	75 51	1 3
0 3	1 013	1561	41 03	−11 7	8 496	5 813	2 1	75 56	1 2
0 4	1 015	1531	42 57	− 4 7	8 258	5 977	1 9	76 58	1 3
0 5	1 021	1531	42 34	− 4 3	8 754	6 302	2 1		
1 0	1 036	1545	40 90	− 3 4				77 08	

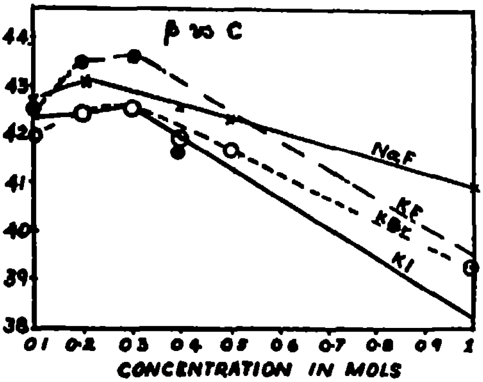

FIG. 1 — Adiabatic compressibility (β) vs molar concentration (c)

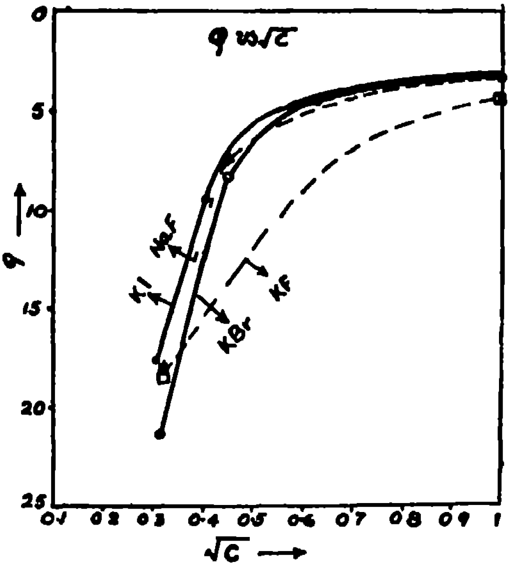

FIG. 2 — Apparent molar compressibility (φ) vs molar concentration ($\sqrt{c}$)

parts in 1000 and this gives an equivalent accuracy to the factors calculated from the values of the velocity.

Discussion

Adiabatic Compressibility — The adiabatic compressibility for the 4 electrolytes chosen of course remains at all concentrations below the corresponding value of water at the temperature at which the experiments were carried out as required by Debye's theory but departs from Bachem's linear relation for the β instead of falling down gradually slightly rises up to a concentration of very nearly 0·3 mol where it shows a maximum and then falls off linearly. It is interesting to note that the maxima correspond to a reduction of β of approximately 4 per cent in the case of KI and KBr and 3 per cent in the case of KF and NaF. This considerably erratic variation of β at very low concentrations lying between 0 to 0·3 may perhaps also be due to the large osmotic activity evidenced at these very low concentrations being superposed on the Debye effect. At comparatively large concentrations say above 0·3 mol the osmotic activity may lessen and hence the Debye effect is the only influencing factor so that β goes on gradually falling.

Apparent Molar Compressibility — The apparent molar compressibility is negative as is the case with electrolytes in general

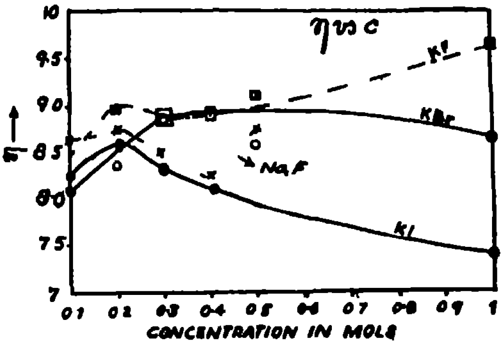

FIG. 3 — Viscosity (η) vs molar concentration (c)

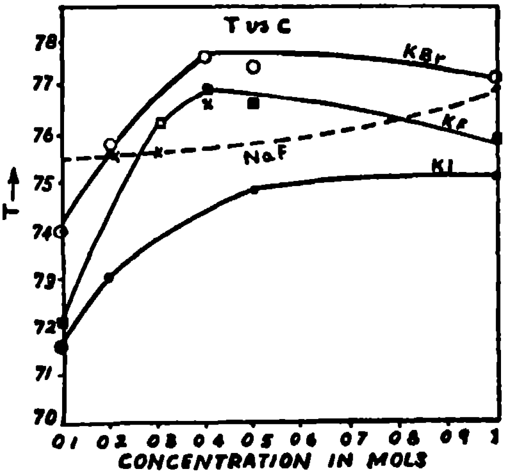

FIG. 4 — Surface tension (T) vs molar concentration (c)

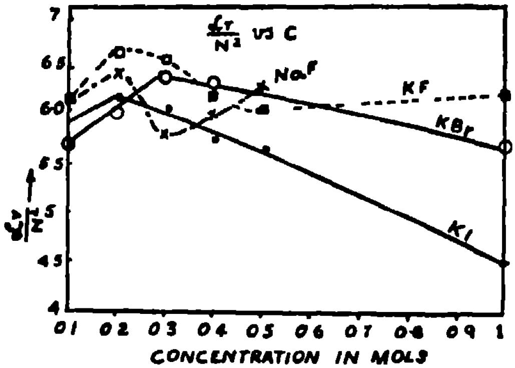

FIG 5 — $\frac{\alpha_r}{N^2}$ VS MOLAR CONCENTRATION
(c) α_r IS THE ABSORPTION COEFFICIENT OF SOUND AT THE FREQUENCY N

But the interest is that all the 4 halides show a departure from the linear relation of Gucker Though no maxima and minima are shown φ first rises with concentration steeply up to a value of 0 5 of $\sqrt{c}$ and then rather flatly It is interesting to note that in the case of all the 4 electrolytes studied the curves are almost parallel to each other which shows that the nature and extent of variation of φ are the same

Viscosity & Sound Absorption — The viscosities mostly remain above the value of water except in the case of KI where after showing a maximum it gradually decreases and goes below that of water An interesting feature shown by the 4 halides is that the curves show a maximum at a concentration of very nearly 0 2 mol The values of η at these points of maxima correspond roughly to 8 per cent rise in case of KI and KBr and 6 5 per cent rise in case of KF and NaF (analogous to the case of fall in β where KI and KBr show the same percentage of fall and KF and NaF a different percentage slightly lower) After the maximum the curves for KI and KBr go on gradually falling off whereas the curves of KF and NaF show a minimum and begin to rise again However, no simple relationship between η and c is possible

It is interesting to note that the curves (FIG 4) representing the relation between calculated values of $\frac{\alpha_r}{N^2}$ (N = 2 5 megacycles per second in these measurements) and c are closely similar to the respective viscosity curves in all the 4 cases

Surface Tension — The surface tension of the solutions of the 4 electrolytes goes on increasing with increasing concentration, though no simple relationship exists between the two The rise is rather steep at first and flat afterwards (between 0 5 and 1 mol concentrations) in case of KI, and reverse is the case of NaF The KBr and KF curves (FIG 5) first rise steeply up to a maximum at 0 4 mol and then show a tendency to decrease slowly

Empirical Relationships proposed in this Investigation — This correlative study of the adiabatic compressibility, ultrasonic velocity viscosity and surface tension has afforded the following empirical relationships at the concentration range chosen

(a) *Between Viscosity & Adiabatic Compressibility* (η & β) — In all the 4 electrolytes the ratio of η to β is a constant, quite independent of the concentration and temperature as can be seen from the values in column 8 Table I The constant is very nearly $2\,0 \times 10^8$ in almost all the cases so that the relationship $\eta = 2\,0 \times 10^8 \beta$ exists

(b) *Between Surface Tension Ultrasonic Velocities & Density* — The simple relationship $T = 1\,2 \times 10^{6}\, \rho v^{\frac{3}{2}}$ is found to exist between T v and ρ at all concentrations in all the electrolytes so that

$$\frac{T}{\rho v^{\frac{3}{2}}}$$

is a constant $1\,2 \times 10^{6}$, independent of concentration and temperature, as can be seen from column 10, Table I

Summary

The adiabatic compressibility in the 4 halide solutions though remains always below the corresponding value of water yet shows a departure from Bachem's linear type of relationship, in the sense that it shows maxima at a concentration of 0 3 mol Above this concentration only it falls off gradually The large osmotic activity evidenced at very low concentrations, it is suggested may have something to do with the cause of the departure

The linear relationship of Gucker, $\varphi = a + b\sqrt{c}$, between φ, the apparent molar compressibility, and $\sqrt{c}$, is not followed by these halides Though no maxima and minima exist, the φ rises steeply first up to a value of 0 5 of $\sqrt{c}$ and is then rather flat.

The curves are closely parallel to each other, showing that the nature and extent of variation of φ with $\sqrt{c}$ is the same in all the halides

The viscosity curves show a maximum at 0 2 mol concentration nearly in all the 4 cases. The curves of KI and KBr run down after the maximum, whereas KF and NaF show a minimum and rise up again continuously

The surface tension, in the 4 cases, gradually increases with increasing concentration

The following empirical relationships have been proposed in the range of concentrations chosen

(1) $\eta = 2\,0 \times 10^{2}\ \beta$ and

(2) $T = 1\,2 \times 10^{-6}\ \rho v^{3/2}$

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The Elastic Properties of Single Jute Filaments: III — Nature of the Torsional Rigidity Modulus

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Jute Technological Laboratories, Calcutta

The nature of the torsional rigidity of single jute filaments, both in the raw and batched conditions, has been studied by using the method of the torsion pendulum A procedure for comparing different jute varieties for twist resistance is indicated.

APPLICATION of twist is of prime importance in the formation of a spun textile yarn. It is immaterial whether the filaments are derived from plant or animal sources, or are regenerated from cellulosic or protein bases, or derived from man-made high-polymers It also does not make any difference, except in respect of degree, as to whether the filaments are long and continuous, or cut to short lengths from such material. Some twist, either a few or even, as for cotton, more than a score over a couple and a half centimetres, needs must be applied in making a usable thread.

The purpose of applying twist may, of course, differ In the case of the continuous filaments like rayon, nylon, etc, which may be made to have any desired length, a few twists only are imparted with a view to make the otherwise slippery materials easy to work with or handle On the other hand, for the relatively much shorter natural fibres, twist happens to be an essential factor for building up of a compact and continuous yarn structure.

Twist always involves a shearing stress So, whenever a twist is applied to a textile filament the rigidity of the filament introduces an opposing force of restitution to counteract the shear that follows the application of torsion The magnitude of this force of restitution varies with the amount of shear imposed, i e the magnitude of the angle through which the material is deformed by the applied twist If, therefore, a torsion pendulum is constructed using the textile fibre for suspension of a suitable "bob", then, between the force of the applied torsion and the proportionally generated one of restitution, a uni-planar periodic oscillation of the bob of the simple harmonic type can be set up The period of oscillation of such a torsion pendulum will depend on the moment of inertia of the oscillating bob and the cross-section of the suspending fibre A very simple relation exists between the modulus of rigidity of the suspending fibre and the period of oscillation of such a pendulum

It is intended in the present article to study the nature of the torsional rigidity of single jute filaments both in the raw and the batched conditions (the filaments being derived separately from the middle and the base of the plant) by using the method of the torsion pendulum The first attempt to measure the torsional quality of a textile filament by this method was by Peirce[1] for cotton Recently Lochner[2] determined the rigidity modulus of wool and other fibres by a similar method which was also adapted to measure the damping capacity

The rigidity of a textile fibre sets a limit to the amount of twist which can be tolerated in a unit length of the yarn of a particular diameter, without detracting from its quality If jute filaments, for example, were less rigid, it would be possible to apply more twist to any particular yarn, within certain limits, without impairing its strength or increasing the stiffness A larger number of twists in a unit length would, under the circumstances, result in greater binding effect and, probably, less hairiness[3] of the yarn The importance of the study of the rigidity of the fibres, in view of its effect on both the utility and the appearance of the yarn, is, therefore, obvious Since the rigidity of a textile fibre may even be varied by appropriate chemical treatment, the importance of the study of this property is further accentuated from the standpoint of reducibility by such treatment

Experimental

Details of the Method — For the purpose of the experiments under consideration, a jute filament was regarded as possessing an *elliptical* cross-section Such an assumption was necessary to make the incidental calculations easy to execute. The true shape of the cross-section of a jute filament is, however, irregularly-polygonal The approximation of the actual polygonal structure to an ellipse is not considered likely to have any significant effect on the precision of the measurement, for, as Smith[4] pointed out, the *shape* of the cross-section of a *textile filament* is much less important for the purpose of calculating the elastic modulus than its *size*

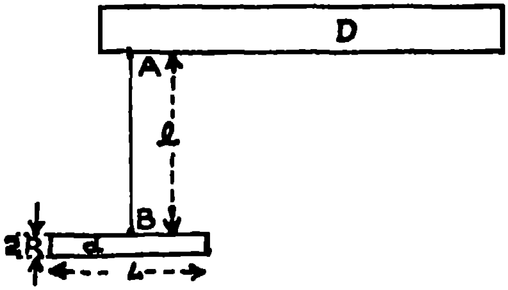

FIG 1 — TORSION PENDULUM
AB, filament, l, length of the filament, D, brass rod, d, aluminium rod, L, length of the aluminium rod, 2R, the diameter of aluminium rod

The construction of the filament pendulum is shown in Fig 1 Here AB represents a single filament, f, of a definite test length, l One end, A, of the filament is fixed with shellac to a brass rod D During an experiment, D is held by a clamp (a_1, a_2, etc, in PQ, FIG 2), such that the end holding the filament is sufficiently projected forward The other end, B, of the filament is attached to the mid-point of an aluminium rod d, of known mass m, and length L and diameter $2R$ The filament, AB, is required to be mounted accurately at right angles to the lengths of the rods D and d respectively When, therefore, D is clamped in a horizontal position, d can oscillate freely in a horizontal plane

The rod d is made to oscillate freely by means of a small, carefully executed push

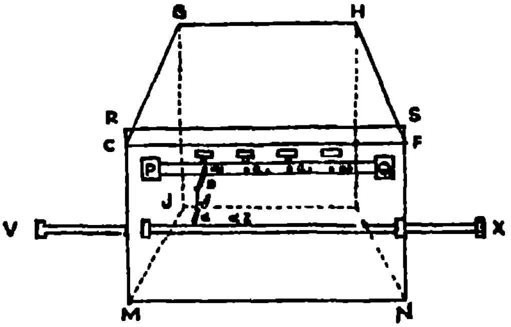

FIG 2 — PENDULUM HOUSE.
GK and RN, glass sides (RN, sliding door), PQ, horizontal rod provided with holes, a_1, a_2, etc, to insert D's, VX, sliding horizontal brass rod mounted with the vibration inducer Z

with the sliding vibration inducer Z (Fig 2) Great care is necessary in executing the push so that the oscillation takes place in the horizontal plane and is of a purely simple harmonic type. Of course, the angular displacement is immaterial, for, even when this is large, the oscillation of a torsion pendulum is accurately simple harmonic[5]

In order to determine with sufficient accuracy the period T of one complete oscillation, it is necessary to note the time taken by 2 to 5 successive oscillations, depending upon the rigidity of the filament For exact measurement of T, the transit of an edge of the oscillating rod across the vertical cross-wire of a telescope was noted

In one set of experiments m, l, L and R are kept constant while the semi-axes of the elliptical cross-sections, a and b, and the period of oscillation, T, vary from filament to filament The rigidity modulus, n, of a filament is derived from a consideration of the moment of inertia of the oscillating bob, the laws of simple harmonic motion, and the physical definition of the modulus of rigidity in relation to the applied torque The formula employed is

$$n = 4\pi\ ml\left[\frac{L^2}{12}+\frac{R^2}{4}\right]\quad\left[\frac{a^2+b^2}{T^2a^3b^3}\right]$$

For a circular cross-section, $a = b = r$ (radius), and so

$$n = \frac{8\pi\ I\,l}{T^2r^4}$$

for, the moment of inertia of the rod d, or

$$I = m\left(\frac{I^2}{12}+\frac{R^2}{4}\right)$$

Peirce has defined this quantity

$$nr^4\ \left(=\frac{8\pi^3Il}{T^2}\right)$$

as the rigidity of the fibre

For the present experiments, a batch of rods, d, was at first numbered serially and kept in separate, correspondingly numbered receptacles The mass and the dimensional particulars, m, L and $2R$ for each rod was determined The values were $m \simeq 0\ 398$ gm, $L \simeq 1\ 88$ cm., and $2R \simeq 0\ 313$ cm

The length, l, of all the jute filaments examined was maintained at 5 cm.

The single filaments were obtained by the method described in an earlier paper[4] The middle point of each rod, d, was marked beforehand by a sharp thin scratch for correct mounting The mounting was done by means of a suitable mixture of good quality red sealing wax and paraffin. The test filaments, after mounting, were conditioned overnight inside a desiccator in an atmosphere of about 75 per cent relative humidity (R H), maintained by using a saturated solution of ammonium chloride Slight variations in R H occurred due to the fluctuation of the room temperature Filaments to be tested were taken out of the conditioning desiccator and placed in position inside the test chamber (Fig 2) in which also the same R H as in the desiccator was maintained, and the period of oscillation, T, determined Later, all the tested filaments were measured for their width with the help of the apparatus described earlier[7] A similar procedure to the previous one reported, was, *mutatis mutandis*, adopted for mounting on the apparatus and also for measuring the width The larger values of width (w_1) were pooled together, as also the smaller ones w_2 w_1 and w_2 corresponded to the axes $2a$ and $2b$ of the elliptical section mentioned above One hundred filaments were examined for each mean value recorded here

Material — The fibre from the crop, the middle and the base portions of the reeds of a single variety, in both the raw as well as the batched conditions, were tested separately The batching and the binning were carried out as for the standard spinning procedure followed up in these laboratories[6] The reference numbers of the tested varieties with the respective measures of yarn quality are given in Table I In the present investigation 5 varieties of jute with widely divergent quality measure were tested

Results

The test material was obtained by sampling as described in an earlier investigation[3]

The arithmetic mean values of the rigidity moduli for the filaments are given in Table II.

TABLE I — THE VARIETIES OF JUTE TESTED

Ref No.	Variety	Quality measure*
J 1760 (W)	*Capsularis*	77
J 1763A (W)	*Capsularis*	64
J 1736 (T)	*Olitorius*	86
J 1749 (T)	*Olitorius*	108
J 1751 (T)	*Olitorius*	97

* The ratio, $\frac{\text{breaking load in lb.}}{\text{grist in lb./spindle}} \times 100$

The arithmetic mean values of the greater (w_1) and the smaller (w_2) widths measured at right angles in a cross-section of the tested filaments are noted for the different test samples in Table III

Discussion

Koshal and Turner[9] found from their studies on cotton that the distribution of fibre rigidity was "extremely asymmetrical" They found the coefficients of asymmetry to vary from +0 096 to +0 351 Individual values, which were sometimes as much as *ten-fold* the arithmetic mean, were observed These two authors followed Peirce's technique in their measurements and did not take into account the actual dimensional measures of the cross-section of the fibres However, the general conclusions reached by Koshal and Turner seem to apply to jute filaments also.

It may be pointed out here that since the occurrence of extreme individual values affect the arithmetic mean, so far as the filament rigidity of a textile material is concerned, the arithmetic mean cannot be taken as an efficient criterion of the overall quality of the material. It is obvious, therefore, that the most important thing about the rigidity of jute filaments is the actual *distribution* of the various rigidity grades in a sample It is possible that this feature characterizes particularly all fibres of natural origin

The distributions obtained from the present experiments are shown graphically

TABLE II — ARITHMETIC MEAN OF THE RIGIDITY MODULI OF FILAMENTS *

JUTE REF No	CONDITION DURING TEST	CROP			MIDDLE			BASE		
		RIGIDITY MODULUS		TEMP (°F)	RIGIDITY MODULUS		TEMP (°F)	RIGIDITY MODULUS		TEMP (°F)
		Mean (10^9 dynes/sq cm.)	S.E		Mean (10^9 dynes/sq cm.)	S.E		Mean (10^9 dynes/sq cm.)	S.E.	
J1760(W)	Raw	4 24	0 235	78	4 07	0 222	84	3 41	0 187	78
	Batched	4 64	0 235	81	3 97	0 209	79	3 53 †	0 224	78
J1763A(W)	Raw	3 11	0 284	74	3 20	0 243	83	5 05	0 267	87
	Batched	2 80	0 289	86	2 81	0 172	82	3 03	0 253	75
J1736(T)	Raw	5 42	0 332	87	4 34	0 245	82	4 92	0 293	81
	Batched	5 21	0 308	86	5 95	0 359	85	6 32 †	0 350	86
J1749(T)	Raw	2 28	0 163	86	2 32	0 152	89	3 21	0 205	87
	Batched	2 22	0 179	87	2 38	0 185	86	2 91 †	0 194	91
J1751(T)	Raw	3 37	0 248	77	2 92	0 212	84	3 01	0 195	87
	Batched	3 00 †	0 209	72	3 57 †	0 244	79	2 70 †	0 151	86

* R H varied between 77 and 79 per cent

† These were tested within 2 or 3 days after batching and binning Others were tested after an interval of more than 10 days after batching

TABLE III — MEAN WIDTHS AT RIGHT ANGLES OF THE CROSS-SECTION OF FILAMENTS

JUTE REF No.	CONDITION DURING TEST	CROP			MIDDLE			BASE		
		Width (10^{-3} cm)		$\frac{w_1}{w_2}$	Width (10^{-3} cm.)		$\frac{w_1}{w_2}$	Width (10^{-3} cm)		$\frac{w_1}{w_2}$
		w_1	w_2	(10^{-1})	w_1	w_2	(10^{-1})	w_1	w_2	(10^{-1})
J1760(W)	Raw	7 218	4 513	6 25	7 287	4 832	6 63	7 950	5 191	6 53
	Batched	7 191	4 475	6 22	7 300	4 674	6 40	8 001	4 996	6 24*
J1763A(W)	Raw	7 908	5 338	6 75	7 622	5 396	7 08	7 456	4 699	6 30
	Batched	7 769	5 712	7 35	7 298	5 273	7 23	7 828	5 824	7 44
J1736(T)	Raw	6 843	3 807	5 56	7 274	4 409	6 06	6 687	4 124	6 17
	Batched	7 076	3 878	5 48	6 545	3 798	5 80	6 634	4 028	6 07*
J1749(T)	Raw	6 925	4 754	6 86	6 559	4 808	7 33	6 234	4 909	7 87
	Batched	7 011	5 014	7 15	7 511	5 356	7 13	5 968	4 659	7 81*
J1751(T)	Raw	6 876	5 194	7 55	6 725	4 734	7 04	6 541	5 138	7 86
	Batched	7 402	5 698	7 70*	5 990	4 417	7 37*	6 992	5 142	7 35*

* These were tested within 2 or 3 days after batching and binning Others were tested after an interval of more than 10 days after batching

in Fig. 3 The extreme asymmetry of the distributions of the rigidity of jute filaments is striking The statistical coefficient of asymmetry, measured by the method used by Koshal and Turner (loc cit), is found to range between +0·027 and +0 325 The range for jute is apparently a little wider than that of cotton. To illustrate the similarity of the nature of actual distributions of rigidity of the jute and the cotton fibres, typical cases of cotton can be seen from Koshal and Turner's report The types for cotton compare favourably with those in Fig 3

Koshal and Turner (loc cit) have explained the observed asymmetry of distribution for cotton fibres in the following words " as the rigidity of the fibre depends upon the square of the area of the cross-section, the observed rigidity will be largely dependent upon the existence of thin places in the fibre, and the effect of such thin places will be exaggerated out of all proportion to their frequency and extent" This view is supported by the fact that jute, despite differences in structure and composition from cotton, exhibits the same kind of asymmetry

It may be noted here that Koshal and Turner presumably assumed *circular* section for the cotton fibre and thus ignored the possibility of unequal inter-fibre or inter-varietal differences in the dimensions of the cross-widths. If the cross-sections are circular, equal amount of variation, when any larger or smaller cross-section is encountered, must occur in the case of *all* the diameters within it The possibility of variation of cross-sectional dimensions is thus very much limited For an *elliptical* cross-section, on the other hand, the variation may occur in either or both the dimensions and the latter simultaneously, in the cross-sections measured for the same or different filaments, and the *extent* of variation may be also the same or different There is thus a very much wider possibility of variation in the cross-sectional areas of filaments of elliptical section than in those of the fibres of circular section This greater possibility of variation in sectional area induces greater liability to produce extremely variable values of the rigidity modulus in the case of jute than in that of any fibre with circular section.

The graphs given in Fig. 3 show that the batching treatment often fails to effect any significant change in the distribution of the rigidity modulus of jute If reference is made to the mean moduli reported in Table II, it is observed here also that while, in some cases, the batched fibre records a lower value of the arithmetic mean, in others, similarly treated, an increase in value over that of the raw fibre occurs Of course, as indicated before, the arithmetic mean provides no precise measure of the quality

But referring to the ratio w_1/w_2, given in Table III, it is found that in most cases a lowering of the ratio to a notable extent results from the batching treatment This indicates the probability of the widths along the two different axes of a cross-section changing differently under the treatment of an oil-water emulsion This may then be regarded as providing more or less an evidence of the constitutional *anisotropy* of the jute filament

Table IV provides the data for the coefficient of asymmetry calculated for the different test samples

It is observed from this table that while in some cases batching induces greater asymmetry of distribution, in others the asymmetry in the raw state is higher Further, one cannot also say that the degree of asymmetry is affected in a definite way by a particular part of the plant stem, viz the crop, the middle or the base.

Now, in a yarn it is the *integrated* rigidity values of the component filaments present in a region which determine the stability of structure in that region There the characters of all the relevant individuals exert *collectively* their full share of influence, *vis a vis* the distribution curve, in bringing about the twist-resisting effect observed in the yarn The smoothed out *average*, such as one obtains by testing a bundle, even if it be of a known number of individuals, is hardly a suitable measure for comparing the structural qualities of yarns It is to be noted also that in testing a bundle of separate entities, as a unit, what is measured is not the pure torsional rigidity, but merely a complex quantity, more or less of an uncertain nature, and determined by the torsional *cum* flexural rigidities of the constituent entities Moreover, the dimensional specifications of such a bundle can only be rather uncertain.

From the above discussion, one may safely conclude that *whether a jute will be, on the whole, more twist-worthy by batching, or by*

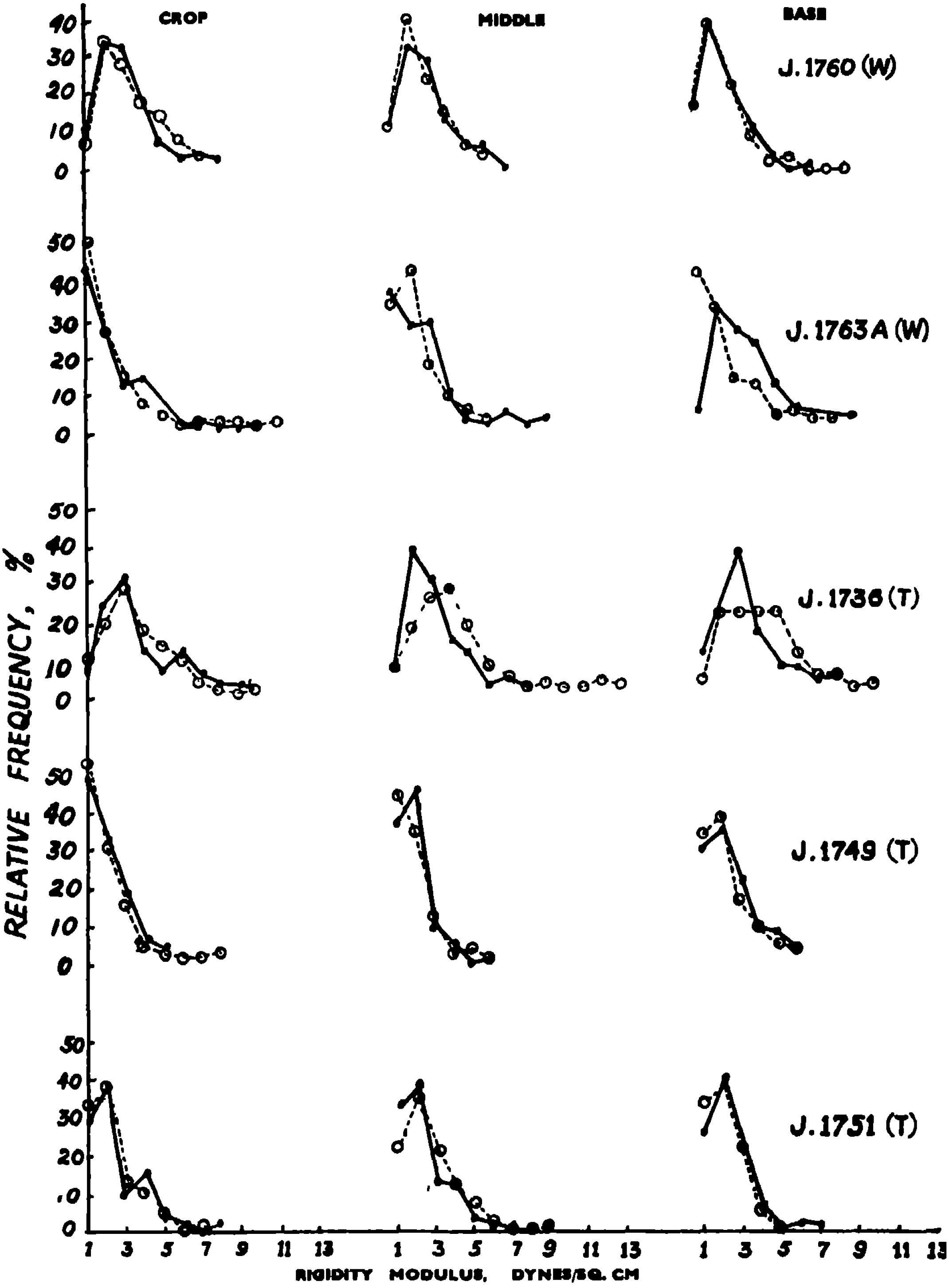

FIG 3 — DISTRIBUTION OF RIGIDITY GRADES IN VARIOUS JUTE SAMPLES

TABLE IV — COEFFICIENT OF ASYMMETRY OF DISTRIBUTION OF RIGIDITY MODULI

JUTE REF No	CROP		MIDDLE		BASE	
	Raw	Batched	Raw	Batched	Raw	Batched
J1760(W)	+0 104	+0 041	+0 155	+0 115	+0 050	+0 104
J1763A(W)	+0 182	+0 418	+0 239	+0 226	+0 107	+0 325
J1736(T)	+0 114	+0 027	+0 131	+0 152	+0 165	+0 157
J1749(T)	+0 287	+0 239	+0 149	+0 258	+0 168	+0 218
J1751(T)	+0 139	+0 248	+0 144	+0 097	+0 128	+0 175

TABLE V — APPROXIMATE PROPORTION (PER CENT) OF FILAMENTS HAVING MODULI OF RIGIDITY NOT EXCEEDING THE ARITHMETIC MEAN

JUTE REF No.	CROP		MIDDLE		BASE	
	Raw	Batched	Raw	Batched	Raw	Batched
J1760(W)	72	64	75	75	58	58
J1763A(W)	67	74	60	73	59	71
J1736(T)	62	56	72	71	67	62
J1749(T)	81	81	83	80	63	71
J1751(T)	67	71	70	57	67	72

sorting out the material from a particular part of the plant, is uncertain

An approximate proportion of filaments whose moduli of rigidity do not exceed the mean value appreciably is given for each sample in Table V

An important point to be noted here is that a majority, and very often a large majority, of filaments considering all the different cases examined, seems to possess a rigidity, the modulus of which does not much exceed the arithmetic mean Therefore, there is a useful application of the mean rigidity modulus also, for example, in the matter of showing up the limit of rigidity within which most filaments may be found to occur *The arithmetic mean of the rigidity moduli may thus provide a rough basis of of comparing different jute varieties for twist-resistance quality*

Conclusions

1 The rigidity modulus of jute filaments is distributed with a distinct *bias* in favour of the small values The distribution possesses features similar to those of cotton

2 The procedure of batching or of sorting from a particular part of the stem does not seem to systematically affect either the mean rigidity modulus or even the distribution of the moduli in one particular direction In other words, batching does not necessarily make a jute more twist-worthy

3 The extreme departure of the distribution of the rigidity moduli from normality precludes any effective study of the character by normal statistics. The different varieties may, however, be more or less roughly compared by the arithmetic mean value of rigidity, because, generally a large majority of the filaments possess a rigidity modulus not much exceeding this limit

4 The variable effect of batching on the mutually perpendicular directions of a cross-section of a jute filament provides an evidence of its probable anisotropic nature

The present work forms the third part of a series of studies undertaken in respect of the elastic properties of single jute filaments The first two parts deal with the flexural rigidity[9] and the creep quality[10] of jute fibres

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Studies in the Chemotherapeutic Derivatives of Acridine Series : Part II — Some Derivatives of 2-Iodo-7-ethoxy-9-substituted Aminoacridine

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2-Iodo-7-ethoxy-9-chloroacridine has been synthesized from two different routes, and condensed with *o*- and *p*-anisidines, toluidines, phenetidines, *p*-chloro-, bromo-, iodo-anilines, 2-aminopyridine and *m*-xylidine. 2-Iodo-7-ethoxy-9-aminoacridine shows marked bacteriostatic action against *Vibrio cholera*, *B shigae*, *B flexner*, *B coli*, *B paratyphosum B* and *Staph aureus*

IN a previous communication[1] it was reported that some derivatives of 2-iodo-7-methyl-9-aminoacridine showed distinct bacteriostatic action The present communication deals with the synthesis of allied compounds in which the methyl group in position 7 has been replaced by ethoxy group, keeping the iodo group fixed in position 2 Ethoxy group is known to confer high antiseptic properties to this class of compounds and the findings of Morgenroth[2] that ethoxy group was the best substituent at position 2 or 7 (both being interchangeable) in the acridine nucleus for enhanced therapeutic properties supports this view The well-known drug " Rivanol " also has an ethoxy group in this position

Singh *et al.*[3] have reported that some N-substituted compounds having *p*-anisidine, *p*-phenetidine, *p*-toluidine and *p*-chloroaniline substituents at position 9 in the acridine series possess considerable antiseptic activity and in some cases these compounds showed preferential action against gram-negative organisms

In view of the above findings, it was of interest to study the influence of *ortho* substitution in some of the radicals which have been found to impart a fair degree of antiseptic activity to the parent compound. *Ortho* anisidine, phenetidine and toluidine have been condensed with 2-iodo-7-ethoxy-9-chloroacridine with this idea in view It may be mentioned that the solubilities of these compounds are considerably more than their *p*-isomers Other substituents at position 9 include *p*-toluidine, *p*-anisidine, *p*-phenetidine, *p*-chloro-, bromo- and iodo-anilines, 2-aminopyridine and *m*-xylidine.

2 5-Di-iodobenzoic acid was condensed with *p*-phenetidine in the usual way and the resulting 5-iodo-N-5′-ethoxy-N-phenylanthranilic acid on ring closure gave 2-iodo-7-ethoxy-9-chloroacridine A confirmatory* synthesis of the above product has also been achieved by the condensation of *m*-ethoxy-6-bromobenzoic acid with *p*-iodoaniline. The resulting 5-ethoxy-N-5′-iodophenylanthranilic acid, on ring closure, gave 2-ethoxy-7-iodo-9-chloroacridine which was identical with the product already described. 2-Iodo-7-ethoxy-9-aminoacridine was obtained from it by adding ammonium carbonate to the hot phenolic solution according to the procedure of Albert and Gledhill[4].

2-Iodo-7-ethoxy-9-aminoacridine has been found to possess high inhibitory action against *Vibrio cholera* in a dilution of 1 3,20,000 and is active against *Staph. aureus*, *B coli*, *B. paratyphosum B*, *B. shigae* and *B flexner* in a dilution of 1 80,000. It shows moderate activity against *B. typhosum A*, and *Proteus X*-19 2-Aminopyridine derivative has also shown moderate activity. Other compounds are inactive The results of the assay have been communicated elsewhere[5].

Experimental

5-Iodo-N-5′-ethoxyphenylanthranilic Acid— This compound was obtained by the condensation of 2 · 5-di-iodobenzoic acid with *p*-phenetidine by the same procedure as reported earlier in the case of *p*-toluidine[1]. The reprecipitated acid, on crystallization from glacial acetic acid, came out in the form of faint-green rhombohydrons melting at 208°-9°C. (yield 80 per cent). Found, N, 3·65 ; M.W., 381 , $C_{15}H_{14}O_3NI$ requires N, 3·68 per cent , M.W., 383

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* This part of the work was done in the National Chemical Laboratory of India, Poona 7.

2-Iodo-7-ethoxy-9-chloracridine — 15 gm of the above acid were refluxed with excess (50 c.c.) of phosphorus oxychloride for 4 hr. at 120°C. in an oil bath Excess of phosphorus oxychloride was removed under reduced pressure and an ice-cold solution of dilute ammonia was added to the contents with constant stirring. The liberated base was filtered and washed with water and dried in vacuum. On crystallization from absolute benzene, it came out in fine silky yellow needles which melted at 170°-72°C Found N, 3·72 , $C_{15}H_{11}ONCl$ requires N, 3·68 per cent

3-Ethoxy-6-bromobenzoic Acid — 20 gm (1 mol) of *m*-hydroxy-6-bromobenzaldehyde were dissolved in 60 c c of 10 per cent sodium hydroxide (1·5 mol) and heated gently under reflux 20 gm (1 4 mol) of freshly distilled ethyl sulphate were slowly added to the above mixture and heating continued for 2 hr The ethylated product separated out as an oil was not purified further but was used as such for oxidation.

17 gm of potassium permanganate and 10 gm. of sodium carbonate dissolved in hot water were added in the course of 1 hr to *m*-ethoxy-6-bromobenzaldehyde heated on a water bath Heating of the reaction mixture was continued for 2 hr more, after which the precipitated manganese dioxide was filtered off and excess of potassium permanganate removed by the addition of a small amount of sodium bisulphite. On acidification with dilute hydrochloric acid, 3-ethoxy-6-bromobenzoic acid came out as a fluffy precipitate which was filtered and washed with cold water. It crystallized from 60 per cent alcohol in colourless slender needles, m.p 115°-16°C Found, C, 48 5 , H, 3 5 , $C_9H_9O_3Br$ requires C, 47 7 , H, 3·67 per cent.

5-Ethoxy-N-5′-iodophenyl-anthranilic Acid – A mixture of 14·2 gm. (1 mol) of potassium salt of *m*′-ethoxy-6-bromobenzoic acid, 16 gm. (1·5 mol) of *p*-iodoaniline, 7 gm (1 mol) of anhydrous potassium carbonate and 20 c.c. of *iso*-amyl alcohol was refluxed in an oil bath at 140°-45°C. for 4 hr A pinch of copper powder was added as a catalyst. At the end of this period, steam was passed through the reaction mixture to remove *iso*-amyl alcohol, filtered hot and acidified with dilute hydrochloric acid. The acid was purified through its ammonium salt which, on crystallization from absolute alcohol, yielded green needles, m.p 208°C. Found N, 3 55 , $C_{15}H_{14}O_3NI$ requires N, 3 68 per cent.

2-Ethoxy-7-iodo-9-chloroacridine was prepared by heating 5-ethoxy-5′-iodophenyl-anthranilic acid with phosphorus oxychloride at 120°C for 4 hr , removing the excess of phosphorus oxychloride under reduced pressure and working out in the usual way. It crystallized from absolute benzene in the form of fluffy yellow needles, m p 170°-71°C. It showed no depression in its melting point when mixed with a sample of 2-iodo-7-ethoxy-9-chloroacridine prepared earlier

2-Iodo-7-ethoxy-9-aminoacridine was prepared in the usual way by adding ammonium carbonate to the hot phenolic solution of the corresponding 9-chloro derivative The hydrochloride, on crystallization from a mixture of absolute alcohol and methanol, came out in the form of deep-yellow needles, m p 302°-4°C (decomp) The base was liberated from it by warming with 2 per cent sodium hydroxide which, when crystallized from absolute alcohol, formed light-yellow needles, m p 244°-46°C Found N, 7 82 , $C_{15}H_{13}N_2OI$ requires N, 7 69 per cent

2-Iodo-7-ethoxy-9-chloroacridine was further condensed with *ortho* and *para* toluidines, anisidine and phenetidines, *p*-chloro-, bromo- and iodo-anilines, *m*-xylidine and 2-amino-pyridine as described in the general procedure below Analytical data for the bases and their hydrochlorides are reported in Table I

General Procedure

The condensation was carried out according to the method of Gilman *et al*[6] 2-Iodo-7-ethoxy-9-chloroacridine (1 mol) was dissolved in phenol at 80°C and 1 1 mol. of the required amine was added to it and the contents heated for 3-4 hr in a boiling water bath When the reaction did not start at this temperature the mixture was heated in an oil bath at 130°-40°C for 3 hr A deep red to scarlet colour change indicates that the condensation has proceeded to completion Ether was added after cooling the contents, when the base hydrochloride separated out It was filtered and washed with ether and acetone The hydrochloride crystallized from glacial acetic acid or absolute alcohol The free base was obtained by treating the

TABLE 1 — 2-IODO-7-ETHOXY-9N-SUBSTITUTED AMINOACRIDINES

SUBSTITUENT AT POSITION 9	BASE	M.P., °C.	BASE HYDROCHLORIDE	M P., °C.	BASE FORMULA	ANALYSIS OF BASE NITROGEN, %	
						Found	Calculated
1 *p*-Toluidine	Yellow prismatic plates	206-207	Golden yellow slender needles	307 308	$C_{22}H_{19}ON_2I$	6 3	6 18
2. *p*-Anisidine	Reddish violet minute needles	234 235	Orange needles	296-297	$C_{22}H_{19}N_2O_2I$	6 1	5 96
3. *p*-Phenetidine	Bright-scarlet stout needles	183-184	Yellow fluffy silky needles	302-303	$C_{23}H_{21}O_2N_2I$	5 7	5 77
4. *p*-Chloroaniline	Chrome-yellow prismatic rods	191 192	Slender yellow needles	300	$C_{21}H_{16}ON_2ClI$	5 9	6 09
5. *p*-Bromoaniline	Greenish yellow plates	172-175	Silky yellow needles	298-299	$C_{21}H_{16}ON_2Br\ I$	5 35	5 50
6. *p* Iodoaniline	Yellow needles	186-187			$C_{21}H_{16}ON_2I_2$	4 9	5 09
7 *o*-Toluidine	Yellow needles	171 172			$C_{22}H_{19}ON_2I$	6 25	6 18
8. *o*-Anisidine	Yellow slender silky needles	164-165	Ruby-red prisms	278	$C_{22}H_{19}O_2N_2I$	5 6	5 96
9 *o*-Phenetidine	Yellow slender silky needles	168-169	Ruby red prisms	258-260	$C_{23}H_{21}O_2N_2I$	5 65	5 77
10. *m* Xylidine	Greenish-yellow plates	176-178			$C_{23}H_{21}N_2I$	6 2	6 20
11 2 Aminopyridine	Yellow needles	176			$C_{20}H_{16}ON_3I$	9 65	9 52

hydrochloride with 5 per cent sodium hydroxide in the hot After drying it could be crystallized from absolute alcohol or suitable mixed solvents. Both the base and the hydrochlorides are not very soluble in organic solvents and solubility in water is poor

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I am thankful to Dr S Siddiqui and Prof Mahan Singh for their keen interest in the work

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Nitration of 4-Chloro-6-methoxy-quinaldine

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The preparation of 4-hydroxy-6-methoxy-quinaldine and its nitro derivative is described. Starting with the nitro derivative, a number of amino and chloro derivatives have been prepared.

IN our attempts to prepare 8-amino-quinoline derivatives (which might find use as possible anti-malarials), it was considered desirable to introduce certain substituents in the pyridine nucleus as it is found that the quinine molecule undergoes biological oxidation at 2-position, and that some of the 4-substituted quinoline derivatives have been found to exhibit pronounced anti-malarial activity Attempts to prepare 8-nitro-4-hydroxy-quinaldine from *o*-nitroaniline and ethylacetoacetate by the method of Conrad and Limpach[1] were unsuccessful, probably due to the presence of *o*-nitro group in the aromatic amine. We have also experienced the same difficulty with regard to 4-methoxy-*o*-nitroaniline.

Halcrow and Kermack[2] have shown that when 4-chloro-quinaldine is nitrated with potassium nitrate and sulphuric acid (100 per cent) the product obtained contains mainly 4-chloro-8-nitro derivative along with some of the 5-nitro and 6-nitro isomers. Hence it would be of interest to study the nitration of 6-methoxy 4-chloro-quinaldine which can be prepared by the condensation of *p* anisidine and ethylacetoacetate

4-Hydroxy 6-methoxy quinaldine was prepared by condensing *p* anisidine with acetoacetic ester according to the method of Conrad and Limpach This was converted to the 4-chloro derivative and nitrated when the 8 nitro derivative was obtained as the sole product The orientation of the nitro group has been established by reducing it to 8 amino derivative and then to 4 6 dimethoxy 8 amino quinaldine Employing Gattermann reaction it was then converted to 4 6-dimethoxy 8 chloro derivative Its identity was established by comparing it with an authentic sample of the same compound prepared by an alternative route i e by subjecting 2 chloro 4 methoxy aniline (obtained by the simultaneous reduction and chlorination of *p* nitro anisole[3]) to Conrad and Limpach reaction The 4 hydroxy 6-methoxy 8 chloro quinaldine so obtained was converted to 4 6-dimethoxy 8 chloro quinaldine

Experimental

4 Hydroxy 6 methoxy quinaldine was prepared by condensing *p* anisidine and ethyl acetoacetate in the presence of an acid catalyst The resulting ester was cyclized in diphenyl ether to get 4-hydroxy 6 methoxy quinaldine which crystallized from ethanol as shining plates m p 317° 18°C (decomp)

4-Chloro 6-methoxy quinaldine—To hydroxy quinaldine (46 gm) was added phosphorus oxychloride (75 c c) and refluxed at 120° 25°C After one hour another lot of phosphorus oxychloride (75 c c) was added and refluxing continued for another two hours Excess of phosphorus oxychloride was removed by distillation under reduced pressure The white residue was then mixed with 700 c c of iced water and well stirred The clear solution obtained was treated with charcoal twice and filtered and the filtrate made alkaline with 20 per cent sodium hydroxide The precipitate was filtered washed free of alkali and dried It crystallized from ethanol as shining crystals m p 92° 93°C Found N 6 69 $C_{11}H_{10}ONCl$ requires N 6 75 per cent

Nitration of 4-chloro 6-methoxy quinaldine — The base (45 gm) was dissolved in sulphuric acid (100 per cent 300 gm) and the solution cooled in a freezing mixture and stirred with a mechanical stirrer Finely powdered potassium nitrate (35 gm) was added gradually over a period of one hour Stirring was continued for two hours and the mixture kept overnight at 15°C The mixture was poured into 600 c c of iced water and made alkaline with 20 per cent sodium hydroxide The precipitate was filtered washed and dried (58 gm) It crystallized from ethanol as shining prisms m p 119° 20°C Found N 10 98 $C_{11}H_9O_3N_2Cl$ requires N 11 09 per cent

4-Chloro 6-methoxy 8 *aminoquinaldine*—The nitro compound (50 gm) was dissolved in concentrated hydrochloric acid (330 c c) and to the solution was added a solution of stannous chloride (160 gm) in concentrated hydrochloric acid (250 c c) and water (250 c c) The mixture was refluxed for two hours charcoaled and the solution filtered hot The filtrate was made alkaline with 20 per cent sodium hydroxide when shining yellow crystals separated out yield 25 gm A portion crystallized from ethanol melted at 100° 101 C Found N 12 48 $C_{11}H_{11}ON_2Cl$ requires N 12 58 per cent

4 6 *Dimethoxy* 8 *aminoquinaldine* — 4 Chloro 6 methoxy 8 aminoquinaldine (2 gm) and sodium pellets (0 4 gm) in absolute methanol (20 c c) was refluxed on a steam bath for two hours Most of the methanol was then removed and the residue was diluted with water and the precipitate filtered washed and dried The residue (2 gm) crystallized from ethanol as shining plates m p 227 28 C (decomp) Found N 12 65 $C_{12}H_{14}O_2N_2$ requires N 12 84 per cent

4 6 *Dimethoxy* 8 *chloro quinaldine* — The aminoquinaldine (1 5 gm) water (5 c c) and conc hydrochloric acid (5 c c) were cooled in a freezing mixture and diazotized with a solution of sodium nitrite (0 75 gm in 4 c c of water) To the diazotized solution was added copper bronze powder (1 gm) gradually with stirring when a light yellow precipitate separated out After the evolution of nitrogen had stopped 20 c c of water were added and the mixture heated on a water bath when the yellow precipitate went into solution It was filtered and the filtrate made alkaline with ammonia The precipitate formed was filtered dried (yield 1 1 gm) and crystallized from water (charcoaled) when white shining plates m p

95° 98°C were obtained Found N 6 08 $C_{12}H_{12}O_2NCl$ requires N 6 29 per cent

2-Chloro 4-methoxy aniline was prepared according to the method of Hurst and Thorpe[3] by the simultaneous reduction and chlorination of *p* nitroanisole with concentrated hydrochloric acid and tin

4-Hydroxy 6-methoxy 8 chloro quinaldine — 2 Chloro-4-methoxy aniline (4 3 gm) was mixed with ethyl acetoacetate (3 6 gm) dilute hydrochloric acid (3 drops) added and the mixture left overnight The resulting ester was separated and dried over anhydrous magnesium sulphate The dried ester (6 5 gm) was added to boiling diphenyl ether (30 c c) and refluxed for 15 min The crystals which separated out on cooling were washed with acetone m p 300° 301°C yield 1 1 gm Found N 6 1 $C_{11}H_{10}O_2NCl$ requires N 6 26 per cent The compound was found to be insoluble in common organic solvents

4 6 *Dimethoxy 8 chloro-quinaldine* — To 4 hydroxy 6 methoxy 8 chloro-quinaldine (0 5 gm) dissolved in 10 per cent sodium hydroxide (10 c c) was added distilled methyl sulphate (2 c c) and the mixture well shaken for half an hour after which it was heated on a water bath for another half an hour Finally it was cooled filtered and the residue washed and dried (yield 0 45 gm) After crystallization from water it was obtained as shining plates m p 95° 96°C This sample when mixed with that prepared by the previous procedure melted without any depression in the melting point

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Chemical Examination of the Seeds of *Cucumis utilissimus* Roxb.

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A detailed chemical examination of oils from seed kernels of two varieties (Lucknow and Saharanpur) of *Cucumis utilissimus* Roxb has been carried out The oils from both varieties are of the semi drying class and are almost identical in composition

CUCUMIS utilissimus Roxb (Hindi *kakri*) belongs to the natural order *Cucurbitaceae* Its seed kernels are edible and are used in confectionery in India a drink made from the ground kernels has a refreshing and cooling effect A detailed chemical examination of the seed kernels of two varieties (Saharanpur and Lucknow) has been undertaken and the results obtained are recorded in this paper The Saharanpur variety is about 1 to 1 5 long and is of green colour while the Lucknow variety is only 9" to 12" in length and is of pale green colour

The seed kernels of both the varieties contain about 43 75 per cent oil having the following fatty acid composition

Acids	*Saharanpur variety* %	*Lucknow variety* %
Lauric	0 12	
Myristic	0 50	2 05
Palmitic	12 8	11 14
Stearic	7 88	3 03
Oleic	27 45	31 18
Linoleic	50 40	52 60

The kernels contain about 37 1 and 35 6 per cent proteins respectively The kernels of both varieties are rich in phosphate (1 02 and 1 13 per cent P_2O_5 respectively)

The unsaponifiable fractions of the oils of both the varieties are partly soluble in hot alcohol, this portion proved to be sitosterol (m.p. 140°C; acetate, m p. 130°-31°C.). The major portions of the fraction, however, crystallized from glacial acetic acid in lamina-like plates melting at 51°C. and proved to be cetyl alcohol (mixed m p with the authentic specimen, 50°-51°C). On oxidation with chromic acid in glacial acetic acid solution, palmitic acid (m p 62°C.) was obtained.

The oils from both varieties belong to the semi-drying class and are of almost identical composition

Experimental

The seeds of Saharanpur and Lucknow varieties contain about 70 and 67 per cent kernels respectively. The powdered kernels were extracted 4 times with petroleum ether (b.p. 40°-60°C) After removing the solvent, 43 75 per cent of clear, light-yellow bland oils were obtained. They had the following characteristics ·

	Saharanpur variety	*Lucknow variety*
Sp gr at 40°C.	0·9145	0·9135
Viscosity at 40°C	39·32 c s.	37 15 c s.
Ref index at 25°C.	1·4730	1·4738
Acid value	5 58	5 54
Sap. value	193 2	189 5
Iodine value (Wijs)	118 5	123 3
Thiocyanogen value	74·95	76 55
Acetyl value	14 9	18 79
Hexabromide value	nil	nil
Unsaponifiable matter, %	0 85	1 83
Hehner value	94 7	93·97
Soluble fatty acids calculated as butyric acid	nil	0 3
Saturated fatty acid, % (modified Bertram method[3])	20 4	16·4

250 gm. of the oil were saponified with alcoholic potash, the alcohol was distilled off and the residual soap dissolved in water The unsaponifiable matter was removed with ether and the soap solution was decomposed with dilute sulphuric acid. When heated on the water bath, the fatty acids formed a clear oily layer at the top They were removed with ether and dried in vacuum at 100°C. The acids (200 gm) were dissolved in 95 per cent alcohol (1,000 c c.), the solution boiled and mixed with a boiling solution of lead acetate (150 gm.) in 95 per cent alcohol (1,000 c c.), the alcohol in both cases containing 1·5 per cent glacial acetic acid. The insoluble lead salts obtained on cooling overnight at 15°C. were crystallized from alcohol containing 1·5 per cent glacial acetic acid when a pale-yellow crystalline material was obtained. The solid acids were regenerated from the lead salts. The liquid acids were recovered from the lead salts left over on evaporation of the mixed alcohol mother liquors The quantities of soluble and insoluble lead salts of fatty acids from both the oils and some of their characteristics are given in Table I.

Soluble Lead-salt Fatty Acids

The soluble lead-salt fatty acids, on oxidations with potassium permanganate (modified Bertram method[3]), gave 1·0 and 2 5 per cent saturated acids respectively

The liquid acids were converted into methyl esters and a known weight was fractionally distilled under reduced pressure[4] The results obtained are given in Table II.

The losses in distillation (1 26 and 1 92 respectively) were proportionately divided and added to each fraction, the saponification and iodine values were determined and the amounts of individual esters in each fraction were calculated These results are given in Tables III and IV respectively

The acids from L-3 and L-6 from both the varieties were oxidized with dilute alkaline potassium permanganate[5] when tetrahydroxy stearic acid (m p 173°C) and dihydroxy stearic acid (m p. 130°C) were isolated from both the fractions. A product melting at 155°-66°C was also obtained which may be an eutectic mixture of α and β sativic acids[6]. The compositions of the soluble lead-salt fatty acids are as follows

	Saharanpur variety %		*Lucknow variety* %	
Lauric acid	0 16	0·95		2·44
Myristic acid	0·64		2·04	
Palmitic acid	0·15		0·40	
Linoleic acid	64·43		61·69	
Oleic acid	34 62		35 87	

The bromine addition derivatives of the soluble lead-salt fatty acids from both the varieties were prepared according to the method of Eibner and Muggenthaler[7] as

TABLE I

FATTY ACID	SAHARANPUR VARIETY				LUCKNOW VARIETY			
	Quantity, %	Neutralization value	Iodine value	Thiocyanogen value	Quantity, %	Neutralization value	Iodine value	Thiocyanogen value
Total		202 8	122 0	77 13		204 1	128 2	82 42
Soluble lead salt	79 35	201 5	148 0	91 96	85 0	202 8	145 0	90 04
Insoluble lead salt	20 65	208 4	4 9		14 10	208 3	6 73	

TABLE II

	SAHARANPUR VARIETY WEIGHT OF THE ESTERS DISTILLED, 105 83 GM			LUCKNOW VARIETY WEIGHT OF THE ESTERS DISTILLED, 96 75 GM		
	Temperature range, °C.	Pressure, mm.	Wt. of fraction, gm	Temperature range, °C.	Pressure, mm.	Wt. of fraction, gm.
L_1	180-195	1 0	7 69	190-195	1 5	11 87
L_2	203 207	1 5	11 50	195-196	1 5	13 50
L_3	208	1 5	10 17	208 210	2 5	7 36
L_4	209 210	1 5	12 11	208	2 0	10 05
L_5	213 214	1 8	12 04	205	1 5	11 62
L_6	215	1 8	14 49	215 216	2 5	14 13
L_7	217 218	1 5	15 34	210	1 5	14 12
L_8	220	1 8	10 15	Residue		12 67
L_9	Residue		11 08			
			104 57			94 82

TABLE III — SAHARANPUR VARIETY

	CORRECTED WT, gm.	IODINE VALUE	SAPONIFICATION VALUE	MEAN MOL. WT	WEIGHT OF ESTERS				
					Methyl laurate	Methyl myristate	Methyl palmitate	Methyl linoleate	Methyl oleate
L_1	7 78	132	195	287 7	0 18	0 32		4 95	2 69
L_2	11 64	137 1	93 0	290 7		0 32	0 10	6 97	4 25
L_3	10 29	140 4	192 1	292 0		0 05	0 07	6 61	3 56
L_4	12 26	142 2	190 3	294 7				7 99	4 27
L_5	12 18	144 3	190 1	295 1				8 22	3 96
L_6	14 67	145 4	190 0	295 2				10 09	4 58
L_7	15 58	147 7	190 2	294 9				11 10	4 48
L_8	10 27	148 5	190 4	294 6				7 43	2 84
L_9	11 21	125 4	189 5	296 1				5 16	6 05
TOTAL	105 83				0 18	0 69	0 17	65 17	36 62

TABLE IV — LUCKNOW VARIETY

ESTER FRACTION	CORRECTED WT, gm.	IODINE VALUE	SAPONIFICATION VALUE	MEAN MOL. WT	WEIGHT OF ESTERS			
					Methyl myristate	Methyl palmitate	Methyl linoleate	Methyl oleate
L_1	11 6	128 9	196 8	285 1	1 15	0 01	6 94	3 50
L_2	13 77	135 1	196 0	287 0	0 67	0 09	8 60	4 41
L_3	7 51	137 5	194 3	288 7	0 22	0 08	4 79	2 42
L_4	10 25	140 6	194 5	288 5		0 20	6 69	3 36
L_5	11 85	143 3	190 4	294 6			7 88	3 97
L_6	14 42	144 8	190 2	294 9			9 81	4 61
L_7	14 42	145 7	190 0	295 2			9 98	4 44
L_8	12 93	119 0	189 8	295 6			4 97	7 96
TOTAL	96 75				2 04	0 38	59 66	34 67

TABLE V

ESTER FRACTION	SAHARANPUR VARIETY: WT OF ESTER DISTILLED, 85 25 GM			LUCKNOW VARIETY: WT OF ESTER DISTILLED, 27 76 GM		
	Temperature range, °C.	Pressure, mm.	Wt. of fraction, gm.	Temperature range, °C.	Pressure, mm.	Wt. of fraction, gm.
S_1	170-181	1 5	4 26	180-182	1 0	4 47
S_2	185-187	1 5	7 85	184	1 5	5 81
S_3	187 190	1 5	5 70	185-188	1 5	6 27
S_4	195 205	2 0	9 44	Residue		5 26
S_5	Residue		7 62			
			34 87			21·31

described by Jamieson and Boughmann[8] The results are as follows

	Saharanpur variety	*Lucknow variety*
Soluble lead salt fatty acids taken for analysis	3 2860 gm	4 2334 gm
Saturated acids from Bertram s method	0 0328 gm	0 1058 gm
Linoleic tetrabromide in soluble in petrol ether (m p 113° 14°C)	2 1609 gm	2 9340 gm
Residue (tetrabromide dibromide and saturated acids)	4 1802 gm	5 2050 gm
Bromine contents of the residue	45 35 %	43 44 %
Linoleic tetrabromide in the residue	2 3067 gm	2 428 gm
Total tetrabromide found	4 4674 gm	5 362 gm
Linoleic acid equivalent to tetrabromide	2 0850 gm (63 45 %)	2 5015 gm (59 1 %)
Saturated acid	1 0 %	2 5 %
Oleic acid	35 55 %	38 4 %

The mean values obtained for these acids from iodine value distillation and bromination results are

	Saharanpur variety	*Lucknow variety*
Saturated acids	0 99	2 48
Linoleic acids	64 21	61 23
Oleic acid	34 80	36 29

Insoluble Lead-salt Fatty Acids

The insoluble lead salt acids after conversion into methyl esters were distilled under reduced pressure The fractions obtained are given in Table V

The losses in distillation were added proportionately to each fraction The iodine and saponification values and mean molecular weights of all the fractions were calculated according to the method of Jamieson and Boughmann[8] (TABLES VI and VII)

The acids from fraction S_2 from both the varieties on repeated crystallization from alcohol gave palmitic acid while those from S_4 on repeated crystallization from alcohol and acetone gave a product melting at 68° 70°C showing it to be principally stearic acid

The amounts of individual saturated components in the insoluble lead salt fatty acids are

	Saharanpur variety %	*Lucknow variety* %
Myristic acid		1 95
Palmitic acid	61 52	76 51
Stearic acid	38 48	21 54

From the above analysis the total fatty acid constituents of the oils from the seed kernels of two varieties of *Cucumis utilis simus* Roxb are

	Saharanpur variety %	*Lucknow variety* %
Lauric acid	0 12	
Myristic acid	0 50	2 05
Palmitic acid	12 83	11 14
Stearic acid	7 94	3 03
Linoleic acid	50 98	52 6
Oleic acid	27 63	31 18

The composition of the two oils therefore are

	Oil from Saharanpur variety	*Oil from Lucknow variety*
Glycerides		
Lauric acid	0 12	
Myristic acid	0 50	2 04
Palmitic acid	12 80	11 00
Stearic acid	7 88	2 98
Linoleic acid	50 40	51 48
Oleic acid	27 45	30 67
Unsaponifiable matter consisting of sitosterol and cetyl alcohol	0 85	1 83

Seed Kernel Cake

The cakes obtained from the seed kernels after complete removal of the petrol ether

TABLE VI — SAHARANPUR VARIETY

	CORRECTED WT gm.	IODINE VALUE	SAPONIFICATION VALUE	MEAN MOL WT	WEIGHT OF ESTERS GM		
					Methyl palmitate	Methyl stearate	Unsaturated esters
S	4 32	2 7	204 8	274 3	3 72	0 52	0 08
S_1	7 96	3 15	203 7	275 4	6 50	1 28	0 18
S_2	5 78	3 27	203 5	275 7	4 65	1 00	0 13
S_3	9 57	4 09	199 2	281 6	5 68	3 61	0 28
S_4	7 72	6 8	189 5	296 1	0 60	6 75	0 37
	35 35				21 15	13 16	1 04

TABLE VII — LUCKNOW VARIETY

	Corrected wt, gm.	Iodine value	Saponification value	Mean mol. wt	Weight of esters, gm.			
					Methyl myristate	Methyl palmitate	Methyl stearate	Unsaturated esters
S_1	4 57	2 2	209 2	266 2	0 41	4 09		0 07
S_2	5 42	3 32	206 1	272 2		5 04	0 26	0 12
S_3	6 40	4 58	202 5	277 0		4 81	1 20	0 2
S_4	5 37	13 45	195 4	287 2		2 04	2 53	0 50
	21 76				0 41	15 98	44 8	0 89

soluble fraction, were analysed according to the method described in the *Official & Tentative Methods of Analysis* The following results were obtained

	Saharanpur variety %	*Lucknow variety* %
Moisture	11 56	9 52
Proteins (N × 6 25)	66·00	63 28
Ash	9·12	9 77
Crude fibre	4·03	4 72
Carbohydrates (by difference)	9 29	12 71

The ash from both the cakes, on analysis, gave 19·79 and 20·52 per cent phosphate calculated as P_2O_5 respectively.

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Destructive Distillation of Some Central Provinces Woods

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The products of destructive distillation of 19 woods from Central Provinces and Berar have been studied. The yields are tabulated.

NEARLY half the area in Central Provinces and Berar is under forest and considerable quantities of charcoal, estimated at 1,80,000 tons, worth Rs. 7,20,000, are being produced by wasteful indigenous methods. If a judicious selection of woods available in the State is made, and if modern techniques of wood distillation are adopted and the by-products recovered, there is scope for establishing a flourishing wood distillation industry in this State.

Nineteen varieties of firewood have been subjected to dry distillation on a laboratory scale and the yields of charcoal and other by-products have been recorded. The results of this exploratory investigation give a fair idea of the suitability of different woods for the wood distillation industry.

Experimental

The apparatus consists of an electrically heated cylindrical mild steel retort (capacity, 1 litre), a Liebig's condenser made of copper, G.I. gooseneck, a water manometer, a 500 c.c. measuring jar which serves as a receiver for the distillate and a wet-gas meter to measure the quantity and the rate at which gases are evolved. The retort was provided with two thermometer pockets for recording temperatures at the periphery and centre of the charge

Distillation Procedure

The wood received in logs (3′ long and 12″ girth) was debarked and chipped to approximately 1″ × 1″ × 2″ pieces About 2 kg of the chips were dried in an air oven at 105°C to constant weight The dried chips were used for charging the retort, which was then heated No attempt was made to control the distillation at the exothermic stage. The heating was stopped when the temperature at the centre of the charge reached 360°C The distillation schedule for one variety of wood is given in Table I

Analysis of Products — The distillate was allowed to settle overnight in a measuring jar and the volume of tar and pyroligneous liquor read off the next day. The acetic acid in the pyroligneous liquor was estimated according to the new method by Warhadpande and Mene[1] Formic acid in the pyroligneous liquor was estimated by noting the difference in total acidity and acetic acidity in 10 c c of the liquor The total acidity was determined by distilling 10 c c. of the liquor with xylene (Grotlisch[2]) and titrating the distillate with N/5 NaOH. Methyl alcohol was estimated according to the method of Griffin[3] Soluble tar was estimated by weighing the residue after evaporating 10 c c of the liquor in a dish and ascertaining the density of the liquor in a Westphal balance The yield of gas was calculated from the gasometer readings The results obtained for 19 different species of woods are given in Table II.

TABLE I

Wood used : Hiwar (A leucophloea), weight of wood, 678 gm., weight of charcoal obtained, 241 gm., settled tar, 45 c.c , total gas evolved, 3 97 cu. ft

TIME	PERIPHERAL TEMP, °C	TEMP AT CENTRE, °C.	TOTAL LIQUOR, c.c.	MANOMETER READING, WATER	REMARKS
11 45 a.m.					
1 25 p.m.	170	115	nil	0 2	Distillation starts
1 35	194	140	10	0 2	
1 45	214	155	25	0 2	
1 50	228	165	35	0 3	
1.55	238	172	46	0 4	Tar distils over
2.00	258	190	110	0 4	Distillate turbid
2.05	274	217	175	0 4	
2.10	284	245	205	0 3	
2.15	290	264	220	0 2	Tar begins to settle and more tar distils over
2.30	302	266	240	0 2	
2.45	314	270	245	0 2	
3.00	324	278	247	0 2	
3.30	342	294	250	0 2	
4 00	360	307	255	0 2	
4.30	378	330	260	0 2	Distillation slows down
5 00	395	352	260	0 2	

TABLE II — YIELD OF DISTILLATION PRODUCTS FROM 100 GM. OF DRY WOOD

NAMES OF THE WOOD		CHARCOAL, gm	ACETIC ACID, gm.	FORMIC ACID, gm.	METHYL ALCOHOL, gm.	SOLUBLE TAR, gm.	SETTLED TAR, c.c.	PYRO LIGNEOUS LIQUOR, c.c.	GAS, litres
Botanical name	Vernacular name								
Schrebera swietenioides	Mokha	34 66	2 22	0 21	1 57	4 30	8 58	28 49	12 61
Zizyphus xylophyra	Ghont	34 65	2 08	0 29	1 72	5 81	6 04	31 42	13 91
Cleistanthus collinus	Garari	37 86	2 56	0 29	1 41	5 26	4 31	35 37	14 49
Dalbergia paniculata	Dhobin	36 29	2 01	0 08	1 24	3 73	5 64	32 08	15 25
Madhuca latifolia	Mahua	37 48	2 06	0 18	1 14	3 50	5 50	30 28	15 47
Aegle marmelos	Bel	34 37	2 42	0 14	0 88	5 25	9 60	35 22	15 37
Emblica officinalis	Aonla	39 16	2 76	0 43	0 80	4 64	5 03	30 00	15 76
Butea frondosa	Palas	39 21	0 86	0 14	1 33	2 30	5 08	26 88	16 91
Diospyrous melanoxylon	Temur	36 58	2 12	0 25	1 24	3 49	6 23	31 65	17·28
Adina cordifolia	Haldu	36 61	1 80	0 30	0 38	4 90	9 30	31 40	15 84
Albizzia odoratissima	Chichwa	36 64	2 01	0 25	0 60	3·49	5 15	25 12	9 96
Schleichera oleosa	Kusum	40 66	1 95	0 20	0 56	3 11	6 89	28 78	14 86
Nyctanthes arbortristis	Kharasi	33 04	3 65	0 10	0 73	6 81	3 87	37·50	15 58
Acacia leucophloea	Hiwar	34 23	2 83	0 06	0 92	4 96	6 31	35 75	16·80
Acacia arabica	Babul	34 98	2 91	0 66	0 44	4 34	5 17	30 26	12 29
Hardwickia binata	Anjan	37 24	2 70	0 28	0 31	5 75	3 91	26 58	13·21
Zizyphus jujuba	Ber	35 61	2 27	0 06	0 40	4 56	5 49	31·21	12 08
Shorea robusta	Sal	37 30	2 50	0 27	0 76	4 91	4 31	28 55	12 85
Xylia xylocarpa	Suria	41 31	1 68	0 25	1 35	3 47	10 05	27 84	18 76

Results

Among the woods investigated Aonla, Palas, Suria and Kusum give the best yields of charcoal (*c* 40 per cent), while others yield 35 to 38 per cent. Kharasi gives the lowest yield (33 per cent)

Kharasi gives the highest yield of acetic acid (3·6 per cent), the yields from other varieties generally vary from 2 to 2·5 per cent

The yield of formic acid varies from 0·08 per cent in the case of *D paniculata* to 0·66 per cent in the case of *A arabica*

The highest yield of wood alcohol was obtained with *Z xylopyra*. The highest yield of settled tar (10·05 per cent) was given by *Xylia xylocarpa*.

The amount of gas generated varies from about 10 to 17 litres per 100 gm. of wood distilled, *D. melanoxylon* (Temur) gives the highest yield (16·91 litres) while *A. odoratissima* (Chichwa) gives the lowest yield (9·96 litres)

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Letters to the Editor

ACTIVATED CHARCOAL FROM GROUNDNUT HULLS

ANNUALLY ABOUT 1,00,000 TONS OF GROUNDnut hulls are available in Hyderabad, which at present are burnt as fuel Nearly 40,000 tons of charcoal are obtainable from this quantity, which may be used as domestic fuel after briquetting. The hulls can be employed also as basic material for the manufacture of activated charcoal

Mukerji and Bhattacharya[1] prepared activated charcoal by heating groundnut hulls in a closed crucible either alone or in presence of zinc chloride The yield of charcoal was poor and the results were not reproducible

A process for the preparation of active charcoal for groundnut hulls, without employing an activating agent, has been worked out in our laboratories.

Experimental

The experiments were carried out in a tube furnace (30 cm. × 2·8 cm). 10 gm. of groundnut hull powder (20 mesh) was put into a quartz tube (1·6 cm. dia.), open at one end, and the tube was placed in the middle part of furnace. The material was gradually heated to the desired temperature, the total period of heating being 4 hr The quartz tube was sealed off after the completion of heating and the contents allowed to cool in the furnace

The charcoal was powdered and the fraction passing through 60-mesh screen used for adsorption measurements[2] Weighed quantities of charcoal were shaken up with iodine, methylene blue and potassium permanganate solutions of known strength for 3 hr and allowed to stand overnight. The charcoal was separated by centrifuging The residual methylene blue was estimated by the colorimetric method. The loss of iodine during centrifuging was corrected by running a control Iodine and permanganate were estimated titrimetrically. The results are recorded in Table I

The yield of charcoal obtained by us is nearly three times that obtained by Mukerji and Bhattacharya[1] who prepared active charcoal having an adsorption value of 760-850 mg. of iodine per gram of charcoal with an overall yield of only 10-13 per cent on the weight of the hulls. We have observed that when carbonization is effected in crucibles where air has partial access to the material inside, there is considerable loss of

TABLE I

S No	Temperature of carbonisation °C	Yield of charcoal	Adsorption per gm of charcoal mg			Log T / 100 X
			Iodine	Methylene blue	Potassium permanganate	
1	320	44	616	30	12	0 049
2	370	41	649	29	126	0 048
3	420		645			
4	500		985		267	
5	640	34	837	30	230	0 045
6	820	31	555		197	0 044

carbon We have further noticed that the activity of charcoal is affected if the charcoal remains in contact with air during cooling

It will be noted that the yield of activated charcoal is related to the temperature of carbonization (FIG 1) The values in the last column of Table I for log T/100 X further show that the volatile matter liberated on heating the husk out of contact with air is proportional to the logarithm of temperature

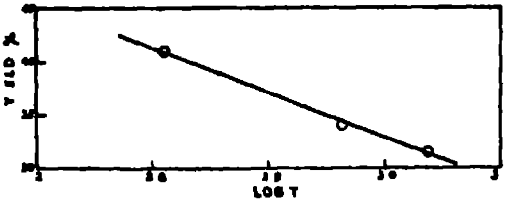

FIG 1 — YIELD OF ACTIVATED CHARCOAL IN RELATION TO TEMPERATURE OF CARBONIZATION

The yield of charcoal diminishes with rise in temperature of carbonization while the activity of charcoal does not vary very much with the temperature of carbonization between 320° 420°C The samples obtained at 500°C show maximum activity The iodine and potassium permanganate adsorption values for samples obtained at higher temperature (820°C) are lower than those at 500°C The results indicate that the optimum temperature for activation is about 500°C

The work is being continued

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A NEW REAGENT FOR URANIUM

OXALO HYDROXAMIC ACID IS FOUND TO GIVE deeply coloured complexes with a number of cations in slightly acid or ammoniacal solutions Special attention has been given to uranium with which the reagent gives an orange complex The formation of this complex has been found to provide a very effective method both for detection and colorimetric estimation of uranium In the absence of excess of electrolytes or in the presence of peptizing agents the orange complex can be kept in solution even in moderate excess of ammonia and serves as a very suitable reagent for colorimetry The maximum absorption of the coloured solution is at 420 mμ and obeys Beer s law closely The limit of identification determined on a spot plate is 0 2γ and the limit of dilution is 1 2 40 000

The applicability of this reagent in uranium ore analysis and the effect of ions like phosphates oxalates iron vanadium alkaline earths etc are being studied and a paper giving complete details will shortly follow

A K DASGUPTA
J GUPTA

National Chemical Laboratory
Poona
August 1 1950

LOW-GRADE CLAY FOR THE MANUFACTURE OF ALUMINA FERRIC

ALUMINA FERRIC IS USUALLY MANUFACtured from rich aluminous ores e g bauxite and kaolin When low grade clay is employed, only a part of the sulphuric acid is utilized and for obtaining a given quantity of alumina ferric a lot more sulphuric acid is required than when bauxite is used The use of low grade clay is thus wasteful of sulphuric acid and the cost of production of alumina ferric is consequently high

A modified process has been worked out in these laboratories for the treatment of low grade clays such as those occurring in Asifabad district Hyderabad State (alumina content 20 per cent) In this process the clay is digested with sulphuric acid (sp gr 1 25) at 105° 10°C for 12 hr Only 70 per cent of the acid is used up The acid remaining over is utilized for digesting the bauxite added to the digestion mixture at this stage The mixture is then heated for a further period of 8 hr A part of the bauxite can be replaced by kaolin In this manner about 99 per cent of the acid is used up

The settling of silica in the digested mixture is slow in the cold but is hastened by warming The rate of sedimentation at 60°C is nearly twice that at 30°C

Calcination of the clay prior to digestion does not offer any advantage calcination at temperatures exceeding 800°C renders the clay less soluble

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APPLICATIONS OF MUSCOVITE CHLORITE SCHISTS

THE MUSCOVITE CHLORITE SCHISTS FOUND IN abundance in Belgaum and Ratnagiri districts of Bombay State are usually considered to be of no economic value although they contain a high proportion of mica Unlike the ordinary mica the mineral is usually found in the highly crushed and stained condition the size of the flakes being very small The mineral can however be easily disintegrated in a hammer mill and the powdered material has the following characteristics moisture 1 22 per cent water solubles 0 74 per cent acid solubles 3 15 per cent sp gr 2 68 and oil absorption 50 39 gm per 100 gm The finely ground powder in conjunction with barium chromate is found to have great potentialities in the formulation of rust resisting primers for structural steel replacing the usual compositions containing red lead Also addition of the powder to distempers to the extent of 5 to 10 per cent results in the prevention of settling and improved washability the coatings having a smoother feel and greater impermeability to moisture The powdered material has also been employed as a filler for thermosetting plastics

Further work on the uses and applications of the powdered mineral as such or after micronization is in progress

N R KAMATH
R K KULKARNI

*Department of Chemical Technology
University of Bombay*

June 22 1950

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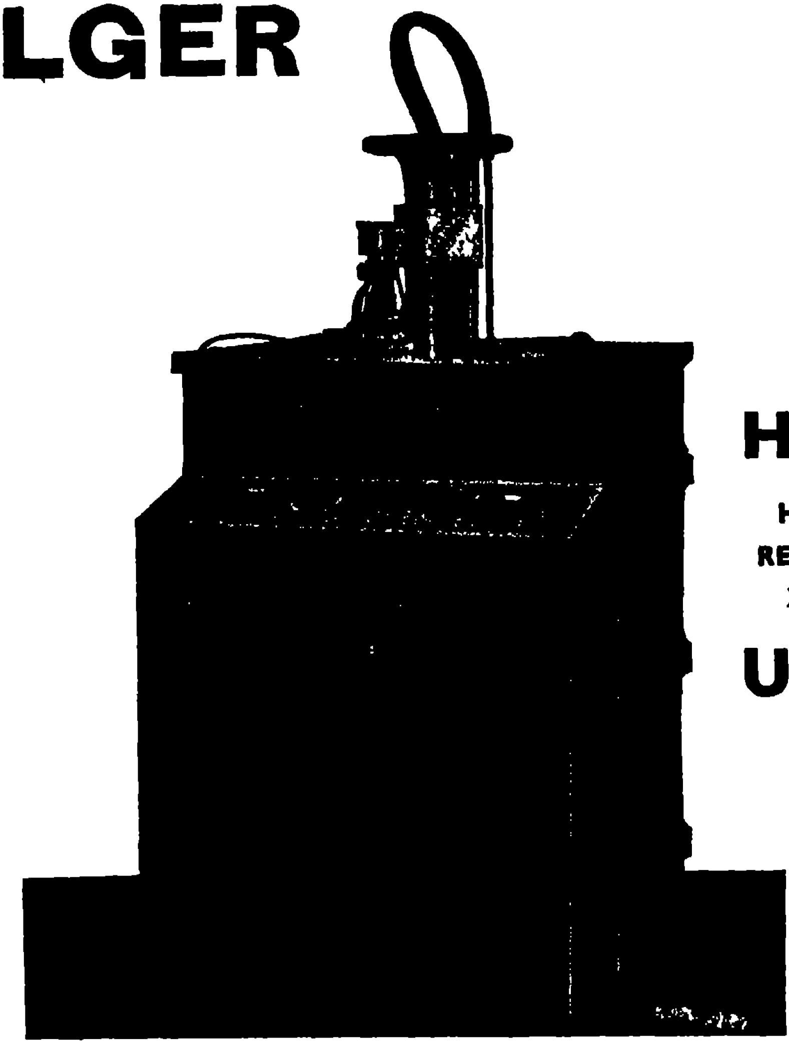

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Simple & Efficient Pentode Scalers

P N SUNDARAM, S K SURI, A SAGAR & U C GUPTA

National Physical Laboratory of India, New Delhi

The design, construction and operation of a number of simple and efficient pentode scalers operating on the power-of-two principle have been described These scalers have a fairly high resolution and give reliable performance. The circuits employed are sensitive only to pulses of negative polarity. The units operate with only one potential supply (+250V, D C.) in addition to the heating units and the need for batteries or auxiliary power supply for grid bias and coupling valves or other complicated units is done away with.

THE scalers described here operate on the power-of-two principle They employ pentode vacuum tubes of the type of 6C6 or 6SJ7-GT or 6SJ7 or 57 These scalers like those of Stevenson and Getting[1], Reich[2] and others[3] as well as those which employ triode vacuum tubes are modifications of the well-known multivibrator circuit[4] These scalers are, in general, based upon the principle of retro-action between a pair of vacuum tubes The symmetry of the circuit of the pair renders the retro-action to have two states of stable equilibrium In one state, one tube of the pair has low impedance and, therefore, is conducting while its mate has high impedance and, consequently, is blocked In the other state the situation is reversed so that the former tube is non-conducting while the latter is conducting

The symmetrical coupling of the pentode vacuum tube pair with which the retro-active circuit is formed may be effected by any one of the various methods described by Regener[5] Most of the existing circuits employ one or the other of these methods of coupling The present scaler circuits differ from most of the existing circuits in so far as they employ a method in which the resistance couplings have been applied between the plates and the screen grids of the opposite of the pair of the circuit of each scale-of-two as shown in Figs 1 and 2

In a symmetrical system such as that illustrated in Figs 1 and 2, when one of the tubes of the pair, say T_2, is blocked, the currents in R_2 and R_3 are the plate current and the screen current respectively of the tube T_1 In this state if the suppressor grid is made negative by a pulse of the order of 8 or 10 volts, the plate current of tube T_1 is cut off and all the current goes to the screen grid developing a state of stable equilibrium As soon as the suppressor returns to zero potential, the system falls into a mode of ignition in which the tube T_1 is blocked and the currents in R_2 and R_3 are the plate and screen currents respectively of tube T_2

It is obvious that only a negative pulse applied to the supressor grid of this pair trips the circuit from one state of stable equilibrium to the other while the situation of the circuit is reversed by means of "retentivity" furnished by R_4, R_5 and C_1 After the pulse is over, if one of the tubes, say T_1, is conducting and its mate is blocked, the current through R_4 produces an additional negative bias on the control grid of T_1 in excess of the bias furnished by the current through R_6 which is common to both tubes This extra negative bias on the control grid which lasts for a period of $t = (R_4 + R_5) . C_1$ survives the triggering pulse in order to reverse the position of the state of stable equilibrium which has been brought forth by the pulse The transmission of the

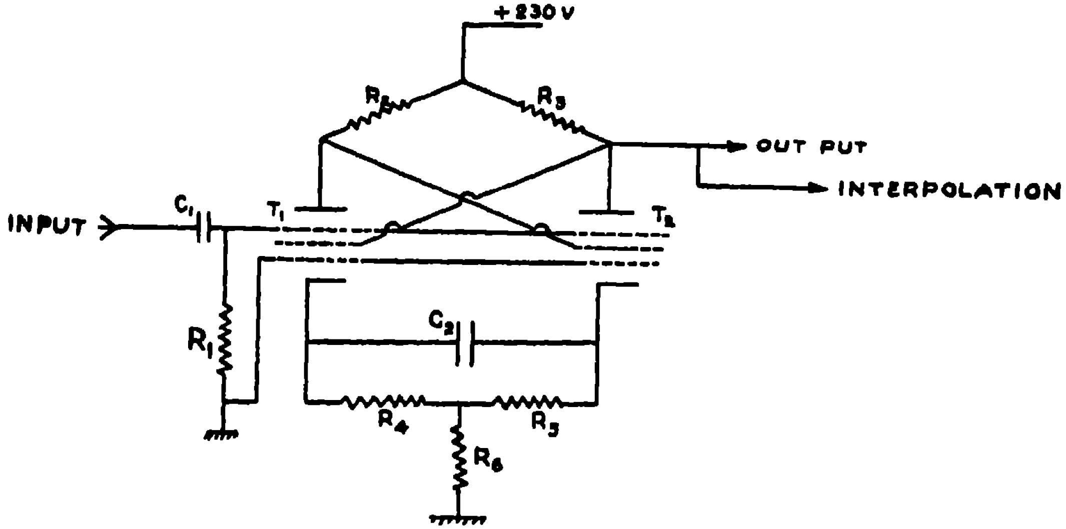

FIG 1 — CIRCUIT CONNECTIONS OF SCALE-OF-TWO $R_1 = 1 m\Omega$ $R_2 - R_3 - 0\,1\Omega$, $R_4 - R_5 = 500\Omega$ $R_6 = 1500\Omega$, $C_1 = 0{\cdot}0001 \mu F$, $C_2 = 0\,1 \mu F$, $T_1 = T_2 =$ 6SJ7

successive pulses of negative potential repeat the process, producing in each plate alternate positive and negative potential changes. If these potential changes of either of the tubes of the pair is transmitted to a thyratron-operated mechanical recorder, which is sensitive only to positive pulses, the scaling action of the counting rate to half the value is accomplished

The circuit is sensitive only to pulses of negative polarity and is unaffected by the pulses of positive potential since they are absorbed by the electron current Because of this property which is unique, two or more units of scale-of-two may be joined together without the necessity of any coupling elements in order to have scalers of multiple-power-of-two The single units such as the one shown in Fig 1 may be arranged side by side, connecting positive to positive, negative to negative and output to input to secure scaling action of higher powers of two In this way scale-of-one thousand twenty-four, scale-of-two hundred fifty-six, scale-of-sixty-four, and scale-of-sixteen have been designed and constructed for counting with high counting rate nuclear particles such as alpha particles, beta particles and gamma or X-photons One of the units (scale-of-256) is shown in Fig 3

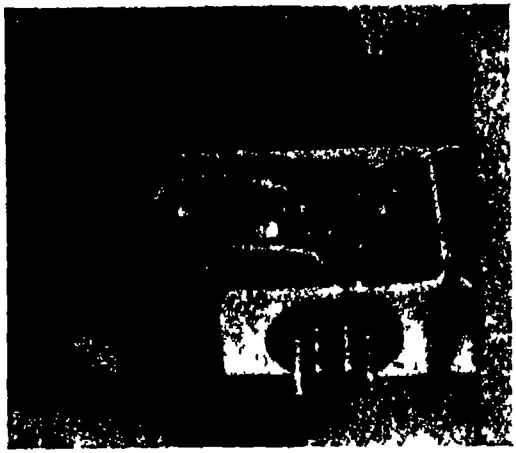

FIG 2 — SCALE-OF-TWO, PLUG-IN TYPE

The construction of these scalers of higher-powers-of-two is simple and straightforward. The relative simplicity of the design and construction has been tested by joining as many as fourteen units of scale-of-two to obtain a scaling ratio 1 16384 The construction of this scale-of-sixteen thousand three hundred and eighty-four did not present any serious difficulty As the scaling is increased, plate and grid voltages and the circuit components, however, have become more critical in value.

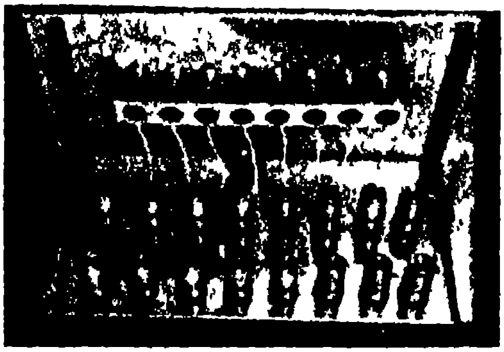

FIG 3 — SCALE-OF-256, BACK VIEW

The interpolation of these scalers are effected by the neon lamp interpolation method which employs miniature neon lamp in each unit of scale-of-two of the multiple-power-of-scale-of-two These lamps are connected through a suitable resistance across the plate of the second tube of each pair to the ground They are lit every time their coupled tubes are driven to non-conducting state and they correspond to the number of counts 1, 2, 4, 8, 16, 32, and so on The sum of numbers assigned to the neon lamps lit gives the number of pulses scored over and above the number recorded by the mechanical counter The actual counts for a given run is the sum of pulses scored by the neon lamps lit and the counts recorded by the mechanical counter

These scalers have a fairly high resolution A scale-of-two unit such as the one shown in Figs 1 and 2, with a few minor adjustments in the circuit components, is found to have a resolution of the order of ten microseconds The scaling units are efficient and sensitive and they, unlike most of the scalers described in literature, are practically insensitive to external radio frequencies and other external disturbances, since the control grids of the pentode vacuum tubes are kept at ground potential Hence they do not require additional screening arrangement even if glass pentode tubes are employed in the circuits

The present designs are of the simplest type and have proved stable and reliable. Each of the scaler units requires only one potential supply (+ 250 V., D C) in addition to that of heating The units do not require batteries or auxiliary power supply for grid bias They need no coupling valves or other complicated units Each scale-of-two unit is very compact The instrument is light and hence easy to transport for outdoor or high altitude work.

The authors are greatly indebted to Dr. Swami Jnanananda for his personal guidance and interest in the work

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Studies in Possible Anti-malarials Part XIII — Biguanido-aryl-arsenicals*

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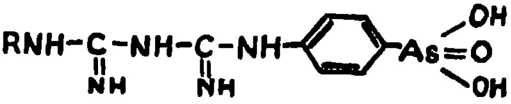
A series of biguanido arsenicals have been prepared and their physical and chemical properties described Some of the biguanido arsonic acids have been reduced to the corresponding arseno derivatives in order to study the efficacy of these trivalent arsenic compounds as chemotherapeutic agents

IN spite of intensive anti malarial therapy a percentage of cases of acute malaria particularly of benign tertian and quartan forms suffers from repeated relapses even for years The modern view about the mechanism of relapses[1, 2] is based upon the existence of the parasites in the liver According to this theory parasites in the blood may be destroyed by the action of quinine atebrin etc the endothelial parasites which are resistant to the action of known drugs survive and can again cause an infection of erythrocytes

The only hopeful approach is to search for a new drug which can free the system from these resistant forms For this various synergy treatments have been advocated with organo metallic compounds Antimony tartrate quinine with stovarsol Na cacodylate etc have been used without much success Recently organo arsenicals have again come into the field A good percentage of cases of chronic malaria has according to Goldman[3] been cured by a single injection of Mapharside (3 amino 4-hydroxy phenyl arsine oxide)

Further studies of Sinton[4] showed that the intravenous injection of sodium stovarsal (3 acetylamino 4 hydroxy phenyl arsonic acid) in benign tertian malaria has produced a true cure in a number of cases Stewards[5] has suggested that a combination of quinine with Mapharside makes a more efficacious remedy than quinine alone Recently Bose[6] has shown that monkeys infected with a highly virulent strain of malaria and having repeated relapses even after treatment with atebrin[7] could be permanently cured of the infection by additional injection of an arsenical drug and with this sequence of treatment on relapsing cases of human malaria[8] the results were very satisfactory Again Paludrine[9, 10] which is a substituted biguanide is said to be the least toxic and the most potent of all existing anti malarials

The above results suggest that it would be interesting and worth while to prepare new compounds in which there will be a continuation of the biguanide residue as also of arsenic acid and to study their anti malarial properties With this object in view a number of new biguanido arsenicals of type A have been synthesized (the pharmacological results will be published later on)



TYPE A

R = H C_6H_5 *p* Cl C_6H_4 *p* MeO C_6H_4 *p* CH_3 C_6H_4 *p* AcNH C_6H_4 etc

It is now widely accepted by pharmacologists[11] that pentavalent arsonic acid becomes therapeutically active only on reduction to the trivalent state in the body In view of these observations some compounds of the type A have been reduced with hypophosphorus acid and potassium iodide to the corresponding arseno derivatives (type B)

The yellow arseno compounds are fairly stable are practically insoluble in water and possess no definite melting points their hydrochlorides melt with decomposition

Diazotized *p* arsanilic acid coupled readily with alkaline cyanoguanidine to give the triazene compound which however could not be denitrogenated to the corresponding

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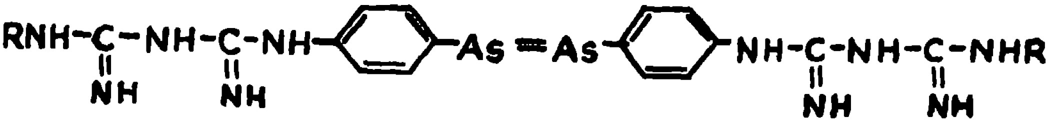
[*] A note on this work has been published in *Curr Sci* 1948 17 126



TYPE B

R = aryl radical

p-cyanoguanidophenyl arsonic acid by any of the existing methods[13] It seems, the presence of negative groups like -ASO$_3$H$_2$ hinders denitrogenation (loc cit , Bami[13])

Experimental

p-Arylbiguanidophenyl arsonic acids (type A) have been synthesized by reacting cyanoguanidine and arylcyanoguanidines with excess of p-arsanalic acid hydrochloride in dilute alcoholic medium The arsonic acids were separated out from the reaction mixture with dilute alkali and purified Compounds No 1 and 10 (TABLE I) were crystallized from a large volume of hot water, the others being insoluble in hot water and common organic solvents, were purified by precipitating with acid from alkaline solution They were soluble both in acids and in alkali and were colourless

Sodium salts were prepared by dissolving the acids in minimum quantity of dilute alkali and precipitating by absolute alcohol The separated sodium salts were crystallized from alcohol All the acids excepting No 10 and their sodium salts contained water of crystallization and did not melt even at 300°C Anhydrous compound No 3 was prepared by heating the sodium salt of N^5-p-chloro-phenyl-(N')-p-biguanidophenyl arsonic acid containing 5 molecules of water of crystallization at 120°-30°C under *vacuo* for 5 hr

Hypophosphorus acid was prepared by the method of Mari[11]

p p^1-Di (N^5-p-arylbiguanido) arsenobenzene (type B) was prepared by reducing the corresponding pentavalent arsonic acid compound with 3 per cent hypophosphorus acid and 3 per cent potassium iodide in an atmosphere of nitrogen at 40°-50°C After filtration and heating again at 50°-55°C for 2 hr, the arseno-compound separated out as a cake which was separated by filtration The precipitate was washed with 10 per cent caustic soda solution followed by 5 per cent warm caustic soda solution, water and alcohol All these operations were carried out in an atmosphere of carbon dioxide The hydrochlorides of these compounds were prepared by heating with dilute hydrochloric acid, on cooling the hydrochlorides separated out and were recrystallized from dilute alcohol

TABLE I — TYPE A

	COMPOUND		FORMULA	FOUND, %		REQUIRED, %	
	R	*X*		*N*	*As*	*N*	*As*
1	p-ClC$_6$H$_4$	H	$C_{14}H_{15}O_3N_5AsCl, 2H_2O$	14 90	16 60	14 90	16 74
2	p-ClC$_6$H$_4$ hydrochloride		$C_{14}H_{15}O_3N_5AsCl, 2HCl$	14 06		14 46	
3.	"	Na	$C_{14}H_{14}N_5O_3AsNaCl$	16 06		16 10	
4	C$_6$H$_5$	H	$C_{14}H_{16}O_3N_5As, H_2O$	17 90	18 76	17 76	17 14
5		Na	$C_{14}H_{15}N_5O_3AsNa, 4H_2O$	14 30	15 75	14 85	15 92
6.	p-OCH$_3$ C$_6$H$_4$	H	$C_{15}H_{18}N_5AsO_4, H_2O$	16 17	17 34	16 47	17 64
7		Na	$C_{15}H_{17}AsNaN_5O_4, 5H_2O$	13 65	14 00	13 48	14 45
8.	p-CH$_3$-C$_6$H$_4$	H	$C_{15}H_{18}O_3N_5As, H_2O$	16 91	18 10	17 11	18 33
9	"	Na	$C_{15}H_{17}O_3N_5NaAs, 4H_2O$	14 41	14 90	14 43	15 46
10.	H	H	$C_8H_{12}AsN_5O_3$	22 95	24 75	23 25	24 97
11	H	Na	$C_8H_{11}AsN_5O_3Na, 6H_2O$	16 00	17 10	16 22	17 40
12.	p-ACNH-C$_6$H$_4$	Na	$C_{16}H_{18}AsO_4N_6Na, 5H_2O$	15 08	13 51	15 38	13 73

TABLE II — TYPE B

	COMPOUND *R*	FORMULA	FOUND, %		REQUIRED, %	
			N	*As*	*N*	*As*
1	p-ClC$_6$H$_4$	$C_{28}H_{26}N_{10}As_2Cl_2, 2 5H_2O$	17 88	19 11	18 25	19 55
2.	p-ClC$_6$H$_4$ hydrochloride	$C_{28}H_{26}N_{10}As_2Cl_2, 2HCl, 2H_2O$	16 75	17 87	16 86	18 07
3.	p-CH$_3$-C$_6$H$_4$	$C_{30}H_{32}N_{10}As_2, 4H_2O$	18 01	19 10	18 56	19 89
4	p-CH$_3$-C$_6$H$_4$ hydrochloride	$C_{30}H_{32}N_{10}As_2, 2HCl, 2H_2O$	17 42	18 41	17 69	18 96
5.	p-OCH$_3$-C$_6$H$_4$	$C_{30}H_{32}O_2N_{10}As_2, 2H_2O$	18 12	19 50	18 66	20 00
6.	p-OCH$_3$-C$_6$H$_4$ hydrochloride	$C_{30}H_{32}O_2N_{10}As_2, 2HCl, 2H_2O$	17 29	17 85	17 03	18 24

The compounds and the analyses are recorded in Tables I and II

Acknowledgement

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Application of Dilatometry to Powder Metallurgy

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A modified horizontal dilatometer has been designed and used to study volume changes of pressed copper powder specimens during heating. The characteristic of the curves showing the relationship between linear expansion and temperature vary with particle size and compacting pressure. Porosity and gas absorption are the two factors which influence expansion in the early stages of heating. Surface tension is the dominating factor at high temperature.

LINEAR changes accompanying transformations in the solid state can be quantitatively measured with the help of a dilatometer In its simplest form the dilatometer consists of a vertical silica tube, one end of which is closed, containing a small silica rod which serves as a support for the test specimen The latter is a cylindrical rod about an inch in length In contact with the upper surface of the specimen is a silica rod extending through the top of a furnace in which the dilatometer is heated. The movement of the specimen relative to the container is indicated on a dial gauge, which magnifies the displacement A thermocouple in contact with the body of the specimen registers the temperature at the instant at which the reading on the gauge is noted.

Other types of instruments, e g Chevenard dilatometer[1], and devices which take advantage of the measurable change in capacity of electrostatic condensers[2], when the distance between the plates is altered, have been employed for measuring dimensional changes in solids subjected to heating The cathode-ray oscillograph has also been employed in dilatometry[3].

The technique of powder metallurgy involves first the compression of metal powder to the required shape, followed by heat treatment during which sintering takes place It is during the latter process that changes in the properties of the pressed compact are brought about The compact undergoes expansion or contraction depending upon the compacting pressure, sintering temperature, particle size and furnace atmosphere A study of dimensional changes in compacts during sintering provides information on the process of sintering and the dilatometer has been employed by a few workers in such studies[4,5].

Experimental

Metal powder compacts invariably undergo oxidation when heated in air even at low temperatures. It is necessary, therefore, that the dilatometer should be so designed as to permit the heating of the test specimen in a neutral or reducing atmosphere It is more advantageous to use a horizontal dilatometer than a vertical one The powder compacts are of low strength and are liable to bend when heated in a vertical position under their own weight The dilatometer described in our studies (Fig 1) consists of a refractory tube A A fitted at both ends with brass flanges B B piecene wax being used at the joints to render them airtight The joints are provided with water cooling coils M The flanges are provided with connections C and D for circulating hydrogen or other gas A small copper tube soldered to one of the flanges facilitates thermocouple connections

One side of the quartz tube is closed by a round brass wall W exactly fitting the face of the flange and supported on a small ring R fitted on the inside of the flange The contact faces of the flange and the brass wall are ground and greased and when placed in position they make a tight fit The second flange (fitted on the other end of the tube) is closed with a bell jar H which rests on the face of the flange plasticine being used for the joint The test specimen S is kept inside the tube in the uniform temperature zone and rests between two silica tubes a platinum platinum rhodium thermocouple passing through one of them A small hole $\frac{1}{16}$″ in diameter and about half an inch in depth is carefully drilled along the length at one end of the specimen and the thermocouple is inserted into it so that the correct temperature of the specimen is indicated The thermocouple leads L are taken out from the inside of the tube through the outlet as shown in Fig 1

Two compression springs (not shown in Fig 1) press the brass wall on to the flange tightly The silica rod is provided with a collar A light spring between the collar and another collar fitted to the brass rod of the flange assures that the specimen is all the while in contact with its accessories A Mercer dial gauge G on the end of the silica rod records the linear changes

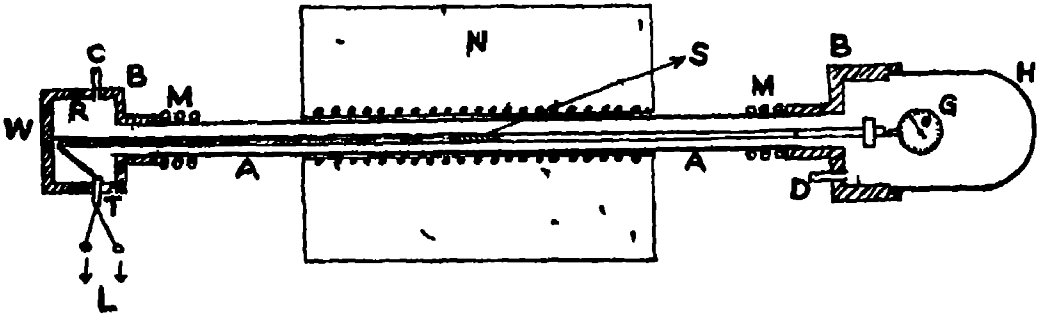
The pressed compact (3″ long × 0 375″ broad × 0 25″ to 0 35″ thick depending upon the compacting pressure used) when heated attains a temperature of 500°C in 20 min 800 C in 32 min and 1 000°C in 45 min This heating rate is maintained in all experiments

Platinum platinum rhodium thermocouple is rendered brittle when heated in hydrogen and has to be annealed after each experiment The method employed for annealing is to pass an electric current through it until the wires become white hot

Single metal powders were used in these studies to avoid complications due to alloying when powder mixtures are heat treated Two grades of copper powder viz —200 to —300 mesh and —325 mesh copper fine both prepared electrolytically and supplied by *Powder Metallurgy Ltd* were employed in these studies The specific surface of the former was 280 sq cm /gm while that of copper fines was 4 000 sq cm /gm

Observations

The characteristic dilatation curves of copper —200 to 300 mesh (Copper C) and copper fines (Copper F) each pressed at



A A refractory tube B-B brass flanges M cooling coils C and D hydrogen inlet and outlet T soldered copper tubing W brass wall R supporting ring S test specimen L thermocouple leads G dial gauge N furnace and H bell jar

Fig 1 — Bell jar horizontal dilatometer

25 and 45 tons per sq in are shown in Fig 2 There are three change points in the curves for both C25T and C45T (Copper C prrssed at 25 tons and 45 tons respectively) The first straight line relationship extends up to 150°C for C25T and 125°C for C45T The coefficients of linear expansion in these ranges are $16\ 5\times10^{-6}$ per °C and $16\ 76 \times 10^{\ 6}$ per °C respectively Pure copper has approximately the same coefficient of expansion The second straight line relationship extends up to about 300°C for C25T and up to 400°C for C451 The coefficient of expansion is higher the actual values being approximately 18×10^{-6} per °C in both cases The third straight line relationship extends up to 600°C for C25T and up to 725°C for C45T In this range the coefficient decreases for C25T ($17\ 9 \times 10^{-6}$ per °C) but increases considerably for C45T ($20\ 15 \times 10^{\ 6}$ per °C)

Changes in the dilatation curves of Copper F25T and Copper F45T (copper −325 mesh pressed at 25 tons and 45 tons respectively) can also be similarly divided into three ranges These ranges and the corresponding coefficients of linear expansion are given in Table I

TABLE I — COEFFICIENT OF LINEAR EXPANSION OF COPPER POWDER COMPACTS AT DIFFERENT TEMPERATURE RANGES

Copper F25T		Copper F45T	
Temp range C	Coeff c ent of l near expans on	Temp range C	Coeff c ent of l near expans on
20–190	$14\ 7 \times10^{\ 6}$	20–160	$15\ 23\times10$
190 300	$17\ 99\times10^{\ 6}$	160 250	$2\ 83\times1\ ^{6}$
300 480	$16\ 33\times10^{\ 6}$	250 500	$15\ 1\ \times10^{\ 6}$

Fig 2 shows that the temperature at which the shrinkage and expansion just balance each other is higher for Copper C than for Copper F This temperature is about the same for Copper F25T and Copper F45T and it is higher for C45T than for C25T When the temperature at which the overall contraction sets in is reached the specimen contracts very rapidly and the dial gauge runs out The dilatation curves are therefore not continued above this temperature

Discussion

A powder compact cannot be expected to expand like a metal rod and if at any temperature the rate of contraction becomes

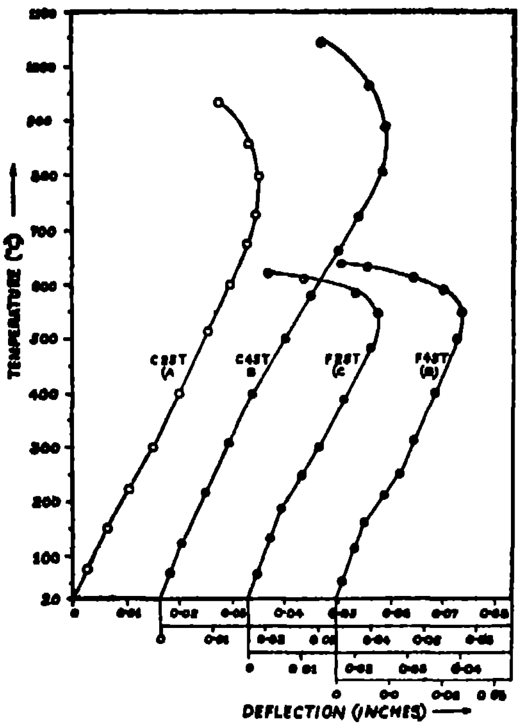


FIG 2 — HEATING CURVES BY THE DILATOMETRIC DETERMINATIONS

relatively more than the rate of expansion then in the absence of any other factor there should be an overall contraction instead of an expansion Other factors which should be taken into consideration are (1) *Adsorbed gases* The amount of gas adsorbed is greater on fines than on coarse powders Trzebiatowski showed that the apparent surface of a copper powder made up of cubic particles 1 mm side is 0 67 sq m/gm The true surface may be 100 times this figure as shown by Bowden and Rideal[6] Assuming an adsorbed film of a gas one molecule thick the possible gas content would be 0 36 c c/gm as calculated by Trzebiatowski (2) *Entrapped gases* Gases may be entrapped during sintering or they may get entrapped as they are evolved when the temperature is raised The entrapped gases affect the volume of the specimen the expansion depending on the readiness with which the gas escapes Recrystallization and grain growth involving reduction in total surface also influence the evolution of gases

Taking all these factors into consideration, the observations may be interpreted as follows

First Range — The coefficient of linear expansion for C25T and C45T in this range is the same as that of the pure metal It is less for Copper F but increases with pressure The coefficients are closely related to porosity While heating the pores are gradually closed and, as the porosity of copper F is high (*c* 30 per cent), considerable expansion is taken in by the pores and the coefficient of expansion is, therefore, low

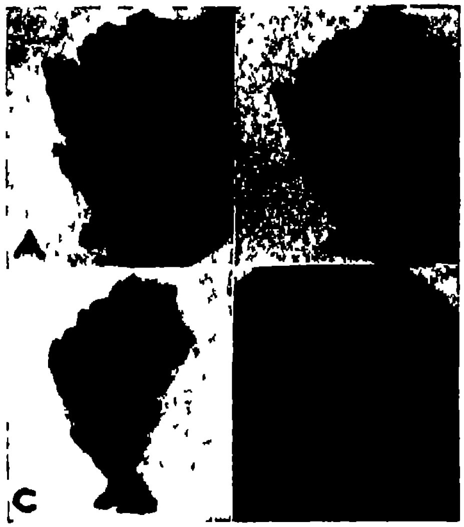
Second Range — The coefficient of expansion in this range is higher than that in the first range In the case of Copper F, it is much more than that in the case of Copper C It is true that the coefficient of linear expansion of copper increases with temperature, but this alone does not account for the large increase observed, especially in compacts of Copper F It is possible that the adsorbed gases evolved during the heating are partly responsible for the high value observed

Third Range — In this range the coefficients decrease in all cases except in the case of C45T It is probable that in this case the entrapped gases cannot escape readily as the inter-particle channels are more tightly closed than in C25T Also, in this range recrystallization and grain growth take place (as shown by microscopic examination), resulting in a reduction in the total surface More gas would be evolved and this would also affect the expansion.

This effect is not noticeable in the case of Copper F45T as the porosity is still quite high (about 40 per cent) and is uniform throughout the specimen

The main difference observed in the curves of powders Copper C and Copper F is at the bends In the case of Copper F the bends are rather sharp

The nature of the force which brings about shrinkage can be well understood by studying a single powder particle heated to different temperatures In Fig. 3 are represented the changes which the particle suffers when heated to 875°, 950° and 1,000°C in succession. A close examination shows that the particle shrinks and the edge gets rounded as the temperature increases. The force which brings about shrinkage, and consequent diminution of surface, is akin to the surface tension. The inward pull on the atoms at the surface is due to cohesion as a result of which the surface has a free energy. The effects of free energy or surface tension are not manifested in changes of form in solids except when the mobility is sufficient for the atoms to move as, for instance, at high temperatures



A, original particle, B, heated to 875°C, C, heated to 950°C, and D, heated to 1,000°C

FIG 3 — SHRINKAGE OF A PARTICLE WHEN HEATED TO DIFFERENT TEMPERATURES (X 75).

The particles of a powder, on account of their high irregular surface, possess surface energy, and this would be naturally more for fine particles than for coarse ones. It must be noted that the photographs refer to a coarse powder in −40 +100 range. The particles in this range can be handled fairly easily The effect of temperature on very fine particles must be more pronounced

Thus it is safe to assume that the coalescence force is the effect of surface tension and the high surface tension of fines accounts for the greater shrinkage (and hence sharp bends in the curve) observed in Copper F compacts.

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Chemical Examination of Castor Oil Gel—Part I

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Castor oil gel is the ultimate product of the prolonged heat treatment of castor oil About 40 per cent of it is soluble in common organic solvents The soluble and the insoluble portions were converted into their methyl esters and subjected to vacuum distillation From the analysis of the methyl esters it has been ascertained that about 75 per cent of the insoluble portion is composed of a mixture of di and tri carboxylic acids

CASTOR oil gel resulting from prolonged heat treatment of castor oil is insoluble in common organic solvents and at present it has few industrial uses With a view to finding some applications for this product a detailed examination of the gel has been undertaken

The principal change occurring during the heating of castor oil is the dehydration of ricinoleic acid chains leading to the formation of glycerides of 9 11 and 9 12 linoleic acids Further heating results in polymerization and in the formation of the glycerides of dimerized linoleic acid and its isomers The investigations of Petit[1] and Champtier and Petit[2] have established the cyclohexenic or hydro aromatic nature of the dimeric fatty acids Bradley and Johnston[3] have indicated the possibility of the formation also of a small amount of trimer As long as cyclization reactions occur within rather than between the fatty acid molecules only the functional groups are affected without any increase in molecular weight The next stage according to Rossman[4] is probably the cyclization of large polymer molecules by intramolecular reaction leading to gelation[5] Flory s theory[6] of gel formation assumes the formation of an intricate network of a large number of molecules formed exclusively by intermolecular reactions Bradley s theory[7] on the other hand suggests that the gel state is due to a mechanically interlinked mesh of cyclized polymer molecules of limited size According to this view some intramolecular reactions as well as polymerization is essential for gelation and formation of insoluble and infusible forms Similar views are held by Farmer[8]

The possibility of the existence of monomeric fractions in the gel is not excluded in the above theories Bradley and Pfann[9] have isolated monomeric fractions to the extent of 24 3 per cent from the hydrolysates of the insoluble gel obtained during the heat treatment of a mixture of oiticica and sardine oils Bradley and Johnston[10] also postulated the existence of cyclic monomers due to thermal decomposition of linoleic acid and oleic acid chains during gelation

The castor oil gel used in the present investigation was prepared from fresh medicinal castor oil of low acid value The oil was heated at 280° 300°C in an air bath 50 c c samples of the heated oil were taken out after every 3 hr and their physical and chemical characteristics were determined The results obtained are given in Table I

TABLE I

	ORIGINAL OIL	SAMPLES TAKEN AFTER			
		3 hr	6 hr	9 hr	11 hr (just before gel formation
Sp gr 40°C	0 9603	0 9467	0 9424	0 9534	0 9557
Viscosity 40 C cent stokes	280 2	196 3	319 0	4128 8	6679 2
Ref index, 25 C	1 478	1 475	1 4805	1 4840	1 4845
Acid val	2 63	11 87	15 62	25 44	19 87
Sap val	183 5	197 8	206 2	222 0	209 0
Iod val (Wijs)	88 0	99 25	115 3	106 3	108 5
Iod val (Woburn B)	92 6	105 6	124 5	115 9	112 4
Diene val (Ellis and Jones	14 8	26 6	26 4	12 9	12 8
Acetyl val	149 5	126 6	69 90	Gelling takes place	

The molecular weight of the oil after heating for 11 hr (just before gelation) was 1,144 as determined by Rast's camphor method

1 *Solvent Extraction of the Gel* — The soluble phase from the brownish-yellow gel was removed by grinding and refluxing with two solvent mixtures A and B, filtering the solution and repeating the treatment till no more soluble portion could be extracted The collected extracts were combined, freed from solvent and dried to constant weights *in vacuo* The yields and characteristics of the soluble fractions are given in Table II

TABLE II

	PETROL ETHER (B P 40° 60° C) 1 PART + ACETONE 2 PARTS (A)	BENZENE 1 PART + ETHYL ALCOHOL 1 PART (B)
Yield of soluble fraction, %	30 2	41 2
Sp gr, 40°C	0 9825	0 9835
Viscosity, 40°C (centistokes)	2641 4	2691 8
Ref index, 25°C.	1 478	1 479
Acid val.	64 6	63 4
Sap. val	230 5	230 6
Iod. val. (Wijs)	64 5	64 4
Iod val. (Woburn B)	66 9	66 3
Acetyl val.	34 7	34 5
Diene val. (Ellis and Jones)	15 1	14 8
Mol. wt. (Rast's method)	650 4	654 8

The solvents were removed from the extracted gel by heating *in vacuo* at 100°C The saponification value of the 2 samples of the gel were 260 0 and 257 5 respectively

2 *Methyl Esters of Soluble & Insoluble Fractions* — 200 gm of extracted (solvent mixture B) gel were refluxed for 4 hr with alcoholic potash and, after separating the unsaponifiable fraction from the hydrolysate by ether extraction, the free acids were freed by acidification with sulphuric acid, extracted with ether and dried at 120°C They were converted to their methyl esters and the polymerized esters were separated from the unpolymerized fractions by distillation under reduced pressures A known quantity of esters was subjected to vacuum distillation and the esters volatilizing at 1 mm pressure were collected The methyl esters of the soluble fraction of the gel and of the oil heated up to the point of gelation were also separated as above. For the sake of comparison the methyl esters of the original castor oil were also similarly treated The yields and characteristics of the different esters are given in Table III

Fractionation of Polymers

For the fractionation of the residual methyl esters of the soluble and insoluble parts of the gel and those of castor oil heated to the point of gelation, the solvent segregation method[11], recommended by Bradley and Bernstein, was adopted[12]

103 gm of the esters dissolved in 50 c c. benzene were shaken up into 200 c c. of 1 1 mixture of acetone and 99 5 per cent methyl alcohol in a separating funnel Water was added till opalescence appeared and the mixture set aside till the separation of the two layers was complete. The lower layer was drawn off The residual fraction was freed from solvent by distillation *in vacuo* This was fraction 1 Three further fractions were obtained by successive additions of water to the solution From the final liquid the last fraction was obtained after complete removal of the solvent The physical and chemical characteristics of the fractions from the different methyl esters are given in Table IV

Discussion

When castor oil is heated at 280°-300°C, its specific gravity, viscosity and refractive index decrease in the initial stages followed by an increase, while the acid, saponification, iodine and diene values follow a reverse order Determination of these values has been followed up to the gelation stage

The molecular weight of the oil heated to the gelation point is 1,144 Bradley and Pfann[9], however, on the presumption that 8 molecules of linoleic acid glyceride are interlinked, estimated that the molecular weight of the gel obtained from a mixture of oiticica and sardine oil is 7,317 But some intramolecular reaction along with polymerization is essential for gelation to the insoluble and infusible form

A study of the characteristics of the methyl esters of the original castor oil, of oil heated to the gelation point and of the two fractions of the gel lead to the following observations

1. The percentage of methyl esters which can be recovered by distillation at 1 mm pressure at 260°C decrease in the following order original castor oil, castor oil just before gelation, soluble portion of the gel and insoluble portion of the gel The distillates are of low molecular weight.

TABLE III

	ORIGINAL OIL			CASTOR OIL JUST BEFORE GELATION			SOLUBLE FRACTION OF THE GEL			INSOLUBLE FRACTION OF THE GEL		
	Total	Distillate	Residue	Total	Distillate	Residue	Total	Distillate	Residue	Total	Distillate	Residue
Yield, %		78 0	22 0		46 9	53 1		25 0	5 0		13 0	87
Sp. gr 40°C.	0 9124	0 9081		0 9193	0 9031	0 9604	0 9397	0 9053	0 9787	0 9495		0 9843
Viscosity 40 C. (centistokes)	17 20	13 5		21 48	6 27	101 4	31 54		171 2	125 5		267 7
Ref. index 25 C	1 4622	1 4618	1 4 45	1 466	1 4506	1 4765	1 4 05	1 445	1 470	1 4 8	1 42	1 483
Acid val.	8 7	1 5	18 2	6 3	3 1	9 0	8 5	3 7	9 2	8 7	7 9	8 9
Sap. val.	180 1	186 2	198 6	205 0	213 0	198 9	223 8	265 0	202 8	237 6	235 0	280 6
Iod. val (Wijs)	88 4	88 1	99 4	90 15	120 4	84 45	60 1	59 34	67 8	60 12	44 02	86 01
Iod. val (Woburn B)	93 8	94 2	108 5	108 5	123 8	9[illegible] 98	65 5	60 46	72 16	65 34	46 32	67 75
Diene val. (Ellis and Jones)	16 1	7 08	9 4	9 0	10 87	6 34	5 1	4 9	4 8	7 3	4 8	5 08
Acetyl val.	148 0			24 0			29 8			21 0		
Mol wt. (Rast s)			551 6		276 3	564 5		254 2	564 0		252 1	580 3

TABLE IV

	CASTOR OIL HEATED TO THE POINT OF GELATION					
	Original	1	2	3	4	5
Weight %		19 54	14 86	1 98	1 [illegible]7	30 35
Ref index, 25 C.	1 4766	1 477	1 4 7	1 47	1 4763	1 475
Iod. val (Wijs)	84 5	88 0	86 0	86 4	85 5	85 9
Iod. val (Woburn B)	92 9	92 0	94 4	95 7	94 9	9[illegible] 5
Sap. val.	198 9	196 2	199 0	19 8	196 0	201 8
Sap equivalent	282 0	285 9	282 0	283 6	283 3	[illegible]78 6
Mol wt.	564 5	580 0	575 3	564 4	55 2	543 3
Basicity of the acid	2 0	2 06	2 04	1 99	1 97	1 95
No. of iod atoms used per molecule	3 74	4 1	3 9	3 8	3 8	3 8

	SOLUBLE FRACTION OF THE GEL				
	Original	1	2	3	4
Weight %		35 81	10 85	15 9[illegible]	37 37
Ref index, 25 C.	1 480	1 481	1 481	1 480	1 4 9
Iod. val (Wijs)	6 8	6 8	6 85	67 42	68 21
Iod. val (Woburn B)	72 16	69 69	2 16	[illegible]3 67	3 58
Sap. val.	202 8	204 8	205	203 8	214 1
Sap equivalent	2 6 1	2 3 9	2 2 7	[illegible]7	262 0
Mol wt.	564 0	569 9	559 0	555 9	531 8
Basicity of the acid	2 04	2 06	[illegible] 05	20 3	2 03
No. of iod atoms used per molecule	3 0	3 1	3 0	[illegible] 9	2 9

	INSOLUBLE FRACTION OF THE GEL					
	Original	1	2	3	4	5
Weight %		35 34	10 50	10 50	14 23	29 43
Ref index, 25 C.	1 483	1 483	1 4640	1 4800	1 4820	1 481
Iod. val (Wijs)	66 01	65 21	6[illegible] 01	68 79	68 98	82 24
Iod. val (Woburn B)	67 75	74 45	72 05	4 3	76 27	84 68
Sap. val.	230 6	225 0	225	230 4	228 9	241 5
Sap equivalent	242 8	240 3	[illegible]49 0	243 4	245 0	232 2
Mol wt.	580 3	586 4	5 8 5	576 4	570 6	565 4
Basicity of the acid	2 39	2 25	2 32	2 36	2 38	2 43
No. of iod atoms used per molecule	3 0	3 0	3 1	3 1	3 1	2 8

2 The molecular weights of the residual methyl esters in all cases vary between 551 6 and 580 3 When the residual fractions of the methyl esters are fractionated by the solvent segregation method a regular gradation in the characteristics is observed The molecular weights correspond nearly to that of the dimer of linoleic acid in all cases

3 The number of double bonds per molecule calculated from Wijs iodine values for residual esters just before gelation is 2 while for that of the soluble and insoluble fractions of the gel is nearly 1 5 The latter value may be due to the presence of esters of dienic and mono olefinic acids

4 The basicity values of the acids of various fractions show that whereas the acids of the residual methyl esters segregated from the castor oil just before gelation and those of the soluble portion of the gel showed a basicity of 2 similar fractions from the insoluble portion of the gel give values varying from 2 25 to 2 43 indicating them to be the mixtures of dicarboxylic and tricarboxylic acids Since the molecular weight of the fraction is below 586 4 the formation of any trimer of linoleic acid is ruled out The presence of some tricarboxylic acid can presumably be therefore explained on the scission and reunion of alkyl chains in different molecules of the dimer in glycerides

5 The hydrolysed product of the castor oil gel may advantageously be used for the preparation of elastomers and higher polymers after condensing with glycols and other polyhydric alcohols The hydrolysed material either as such or after modification with drying oils may be used as a coating composition The di and trivalent salts of the hydrolysate have already given satisfactory results as substitutes for ester gum and oil varnishes and as solvent lacquers Work on the hydrolysis of castor oil gel under steam pressure is in progress

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Extraction of Germanium from Sphalerite Collected from Nepal—Part I

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A method for the extraction of germanium from the magnetic fraction of the mineral sphalerite has been described The fraction which is shown to be magnetite contains 0 24 per cent germanium

IN a previous communication[1], we described a magnetic fraction of the mineral sphalerite collected from Nepal On chemical analysis, this fraction was found to be mainly ferric oxide with a coating of ferrous sulphide It contains germanium to the extent of 0 24 per cent That the mineral is magnetite has also been confirmed by X-ray analysis Coal ash, euxenite and some specimens of zinc blende are known to contain germanium in small quantities, but its association with magnetite has not been reported

Experimental

Analysis of the Mineral — The spectrogram revealed the existence of iron, silicon, lead (trace) and germanium

Total Iron — A weighed amount of finely powdered mineral was dissolved in 1 1 hydrochloric acid and the total iron estimated by titration with potassium dichromate after reduction with stannous chloride

Silica was estimated by the usual method, and the value verified by determining the loss in weight by treatment with hydrofluoric acid.

Sulphur — The mineral was decomposed with sodium peroxide and the sulphur estimated as barium sulphate

Ferrous iron was estimated by decomposing the mineral with 5 c c of concentrated hydrochloric acid and 10 c c of hydrofluoric acid in an atmosphere of carbon dioxide, and subsequent titration with potassium dichromate using diphenylamine sulphonate as indicator

Germanium — Of the various methods known for the estimation of germanium[2-5], Orliac's colorimetric method[6] with slight modification was found to be the most convenient A weighed amount of the mineral was carefully roasted at 500°C in an electric furnace and transferred to an all-glass distillation apparatus 40 c c of 1 1 hydrochloric acid were added and the flask gently heated in a current of air. The distillate was collected in a flask containing dilute caustic soda solution and a drop of phenolphthalein indicator solution After the distillation was complete, the solution was acidified with dilute hydrochloric acid and the volume made up to 100 c.c. To 10 c c of this solution, 1 c c. ammonium molybdate solution (9 per cent) and 10 c.c. of alkaline potassium stannite solution containing 5 gm. of hydrated stannous chloride and 300 gm. of potassium hydroxide per litre were added and the total volume made up to 40 c c A series of standard solutions of germanium tetrachloride were

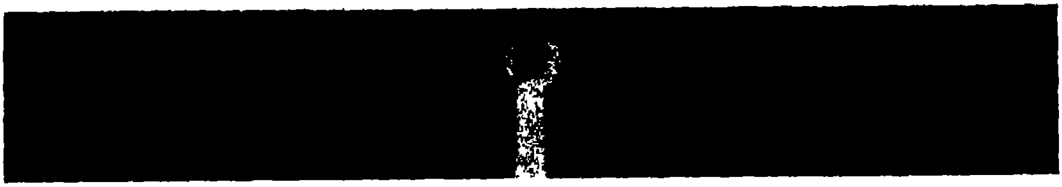

FIG 1 — X-RAY POWDER DIAGRAM OF THE NON-MAGNETIC PORTION FROM THE MINERAL SPHALERITE

prepared and the same volume of ammonium molybdate and alkaline stannite were added and the total volume in each case made up to 40 c c After an interval of 5 min the transmittancies of the solutions were determined in a Lumetron photo-electric colorimeter, using 440 mμ filter, and a standard graph was constructed From this graph germanium in the mineral was found to be 0 24 per cent

The results of the analysis are tabulated below

	%		
Total iron	69 5	Fe_2O_3	66 28
Ferrous iron	23 1	FeO	27 02
Sulphur	1 10	FeS	3 27
Silica	2 16	SiO_2	2 16
Germanium	0 24	GeO_2	0 34
			99 07

The mineral is apparently magnetite with a coating of ferrous sulphide. This has now been confirmed by X-ray powder diagram kindly supplied by Mons Pierre Urbain, Director, Hydrological Institute, Sorbonne, Paris The rontgenogram is reproduced in Fig 1

Extraction of Germanium Dioxide — None of the methods employed by Winkler for the extraction of germanium from Argyrodite was adopted, as the associated elements in this mineral are quite different from those in Argyrodite After various trials the final procedure adopted was based upon the volatility of germanium tetrachloride and is an elaboration of the procedure described by Buchanan[2].

160 gm of the finely powdered mineral were roasted in an electric muffle at about 550°C for 12 hr when all the sulphide was converted to sulphate and oxide The roast ore was transferred to an all-glass Claisen flask. 400 c.c of 1 : 1 hydrochloric acid were added and germanium tetrachloride distilled off in a current of hydrochloric acid gas till the volume is reduced to one-fourth This distillation was repeated with further additions of hydrochloric acid A rapid stream of hydrogen sulphide gas was then passed through the distillate for about 15 min when a milky precipitate of germanium disulphide was obtained (for complete precipitation, the acid strength was maintained at 4N to 6N by the addition of concentrated hydrochloric acid) The mixture was set aside in a stoppered bottle for 48 hr, the sulphide separated by filtration and washed with 6N sulphuric acid saturated with hydrogen sulphide till it was free from chloride The precipitate on the filter paper was treated with aqueous ammonia (about 8N) and the filtrate collected The germanium disulphide was thus obtained as the thio-salt The filtrate was evaporated, hydrogen peroxide added and again evaporated to dryness The dried mass was carefully heated to remove ammonium sulphate completely, transferred to a crucible with water, evaporated and finally ignited to germanium dioxide at 600°C. The yield was 330 mg

The spectrum of germanium dioxide thus obtained reveals the existence of traces of iron, lead, phosphorus (impurities from the hydrogen peroxide used).

Acknowledgement

Our grateful thanks are due to Prof P B. Sarkar for his keen interest in this investigation, and to the *Council of Scientific Industrial Research* for granting a scholarship to one of us (R K Dutta)

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Factors Affecting the Properties of Typical Zircon Porcelain—Part I

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Lime is a useful flux in zircon bodies, whether it is added as calcium-ziroconium silicate, whiting or wollastonite These fluxes either individually or in combinations do not markedly influence the maturing characteristics and fired properties of typical zircon porcelain bodies processed by the dry-press method. The forming pressure rather than the pressing technique is important in the control of fired density. All the three fluxes are suitable, when used individually, for the production of earthenware and semi-vitreous bodies.

AN appreciable amount of work[1-8] has already been done on zircon porcelain compositions and useful fluxes such as whiting and calcium-zirconium silicate in zircon porcelains have also been investigated in this laboratory by previous workers[3] The present investigation was undertaken to study the relative merits of different methods of incorporating the alkaline earth fluxes in typical zircon porcelain compositions[4]

Experimental

The raw bodies were so compounded that the fired body composition in each case was as follows

Weight per cent Composition

		%
Al_2O_3,	2 SiO_2	19
ZrO_2,	SiO_2	72
CaO		9
		100

Dividing by the Respective Molecular Weights

Al_2O_3,	2 SiO_2	19/222	0·09 mol
ZrO_2,	SiO_2	72/182·9	0·39 mol
CaO		9/56	0·16 mol
			0·64 mol

Hence, mol per cent composition of the body was, in each case, as follows

			%
Al_2O_3,	2 SiO_2	$\frac{0·09 \times 100}{0·64}$	= 14
ZrO_2,	SiO_2	$\frac{0·39 \times 100}{0·64}$	= 61
CaO		$\frac{0·16 \times 100}{0·64}$	= 25

Mol per cent composition of fluxes in various raw bodies is indicated in Fig 1, and the composition of the raw body is calculated as follows Each mol of calcium-zirconium silicate supplies a mol of CaO and a corresponding mol of ZrO_2, SiO_2 This was taken into consideration and the proper adjustment made when adding zircon to the body Wherever wollastonite was used as a source of CaO, it provided a corresponding mol of SiO_2. This amount

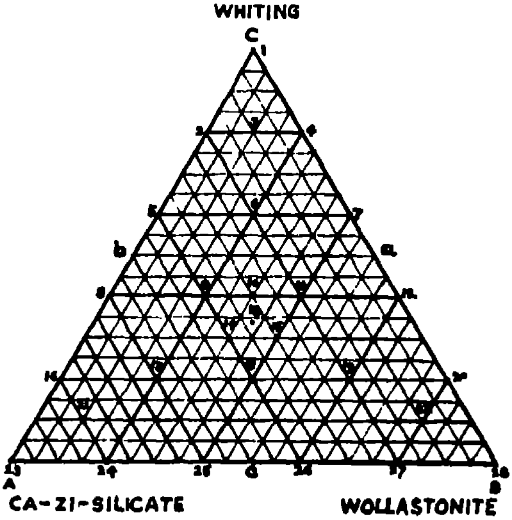


FIG 1 — MOL PER CENT COMPOSITION OF FLUXES IN RAW BODIES.

of silica provided by wollastonite was considered as excess silica in that particular body and it was not taken into account when adjusting the molecular composition of the body In making these calculations the theoretical and not the actual molecular weights of the raw materials were used

The following raw materials were used

1 *Milled Zircon* (*Titanium & Alloy Manufg Co Niagra Falls New York*)

Analysis

	%
ZrO_2	64 3
SiO_2	35 0
Others	0 7
TiO_2	0 1
Fe_2O_3	0 05
Reported fineness	0 1 retained on 325 mesh
Determined fineness	0 27 retained on 325 mesh

2 *Calcium Zirconium Silicate* (*Titanium & Alloy Manufg Co Niagra Falls New York*)

Analysis

	%
ZrO_2	52
SiO_2	26
CaO	22
Reported fineness	0 1 on 325 mesh
Determined fineness	0 19 on 325 mesh

3 *Florida Kaolin* (*Edgar Plastic Kaolin Co Metuchen N J*)

Analysis

	%
Al_2O_3	36 75
Fe_2O_3	0 80
CaO	0 15
TiO_2	0 18
MgO	0 20
SiO_2	46 95
KNaO	0 24
Ignition loss	14 95

4 *Whiting* (*Columbus Dental Manufg Co Columbus, Ohio*)

Analysis

	%
$CaCO_3$	98 5
MgO	0 5
SiO_2	0 8
Al_2O_3	0 1
Others	0 1

5 *Wollastonite* — *CaO SiO_2* (*Foote Mineral Co Philadelphia Pa*)

Analysis

	%
SiO_2	49 8
Al_2O_3	2 7
CaO	46 5
Fe_2O_3	1 1
Observed fineness	14 0 retained on 200 mesh (mainly coarse red sand) ground to pass through 200 mesh by wet grinding before being used

The compositions of the raw bodies are given in Table I The body in each case was prepared by wet ball milling and drying in a steam heated drier (temperature 60°C) and subsequently pulverized in a Braun disc pulverizer avoiding excessive fines

The test specimens were formed by dry pressing in a steel die at 4 000 p s i using a manually operated Carver laboratory press 7 per cent by weight of a 5 per cent dextrine solution was used as the binder in preparing the pressing batch Discs 2" in dia (3 sq in in area) and approximately ¼" thick were prepared for the vitrification studies The following bar specimens were prepared for those bodies (three end members of the tri axial i e Nos 1 23 and 28)

TABLE I — EFFECT OF FLUX SELECTION ; BODY COMPOSITION IN PERCENTAGE BY WEIGHT

Body No	Zircon %	Florida kaolin %	Whiting %	Ca Zr SiO_3 %	Wol[illegible]to[illegible]
1	64 6	20 9	14 5	0 0	0 0
2	60 1	21 2	11 7	7 0	0 0
3	62 2	21 0	11 6	3 5	1 7
4	64 3	21 8	11 5	0 0	3 4
5	55 4	21 5	8 9	14 0	0 0
6	59 8	21 1	8 8	7 0	3 4
7	64 0	20 7	8 7	0 0	6 7
8	60 6	21 7	6 0	21 6	0 0
9	55 0	21 6	6 0	14 0	3 4
10	57 4	21 2	5 9	10 5	5 1
11	59 5	21 0	5 9	7 0	6 8
12	63 7	20 6	5 8	0 0	10 0
13	57 1	21 4	4 6	10 9	5 8
14	55 0	21 3	4 4	14 0	5 1
15	7 2	21 1	4 4	10 5	6 8
16	45 8	22 0	3 1	29 2	0 0
17	50 4	21 6	3 0	21 5	3 5
18	56 0	21 2	3 0	14 0	5 8
19	59 2	20 9	2 9	6 9	10 1
20	63 4	20 5	2 8	0 0	13 2
21	45 0	21 6	1 5	28 6	1 6
22	61 2	20 7	1 4	3 5	13 3
23	40 9	22 4	0 0	37 1	0 0
24	45 5	21 0	0	29 0	3 5
25	50 2	21 5	0 0	21 4	7 0
26	54 7	21 2	0 0	14 0	10 2
27	59 0	20 8	0 0	7 0	13 3
28	63 1	20 3	0 0	0 0	16 4

included in the final study of fired properties

12 specimens, each of 5″×1″×¼″, for the determination of the following (a) total shrinkage and fired transverse strength, (b) warpage during firing, (c) fired translucency and broken bars were employed for bulk and apparent specific gravity and per cent absorption 2 specimens, each 5″×¼″×1¼″, were prepared for the determination of the coefficient of thermal expansion

The specimens for the determination of the fired translucency were wedge shaped (0-¼″) with a "clipper" abrasive wheel

The test pieces were dried in a steam-heated drier (60°C) and subsequently fired in a muffle type electric glober kiln The temperature was increased at the rate of 350°F. per hour to within 2 cones of the ultimate end point

A soaking period of 3-4 hr was allowed

Water absorption tests were conducted in the conventional way and per cent absorption was considered as the criterion of the progress of vitrification

The shrinkages were determined as follows

$$\text{Per cent total shrinkage} = \frac{\text{Formed length} - \text{fired length}}{\text{Formed length}} \times 100$$

A Dillon testing machine was used for the determination of fired transverse strength

Translucency was determined by sliding a wedge-shaped test piece from the thickest to the thinnest end over a narrow slit in the cover of a box containing a 60-watt Mazda lamp The thickest cross-section (measured to an accuracy of 0·001″) of the specimen where the slit was just visible was reported as the translucency value An average of 4 measurements, using 2 specimens, is reported

The thermal expansion determinations were made in a fused quartz tube dilatometer designed by the U S Bureau of Standards in which the expansion of the test bar (5″ × ¼″ × ¼″) is measured by an Ames dial graduated to 0 001″

Discussion

Effect of Flux Selection on Maturing Characteristics — The results of the effect of flux selection upon the maturing characteristics of the various bodies are presented in Table II It is evident from Table II that the vitrification range was in no case greater than one Orton cone which is shorter than that preferred for commercial firing. The use of the fluxes, individually or in various combinations, does not show any difference in influencing the maturing characteristics of vitreous bodies, the effect was somewhat more pronounced in porous bodies

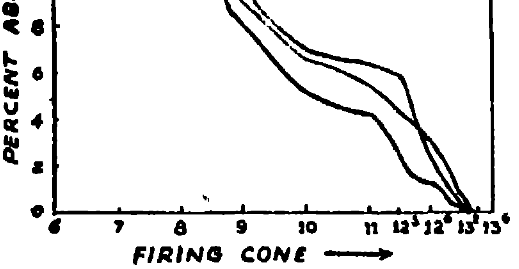
TABLE II — EFFECT OF FLUX SELECTION; PER CENT ABSORPTION VS. FIRING CONES

Body No	Firing cones							
	8°	9°	10°	11°	12°	13°	14°	15°
1	15 40	10 60	6 80	6 30	2 00	0 00	O F	O F
2	16 48	8 65	5 47	5 21	2 08	1 39	O O	O F
3	17 12	9 88	5 82	5 16	2 24	0 04	O F	O F
4	20 45	13 70	10 24	9 56	6 85	0 10	O F	O F
5	14 75	9 05	4 22	2 46	1 54	0 00	O F	O F
6	15 40	11 39	7 16	5 92	5 78	1 41	O.O	O F
7	16 62	13 84	10 56	10 15	5 55	0 00	O F	O F
8	13 28	8 35	6 62	5 97	1 98	0 00	O F	O F
9	13 87	9 45	7 16	6 07	4 05	0 00	O F	O F
10	13 55	11 64	8 60	6 46	5 68	0 10	O F	O F
11	17 62	11 06	8 95	8 54	5 40	0 08	O F	O F
12	15 90	14 82	12 30	7 47	6 34	0 00	O F	O F
13	18 13	12 05	9 14	8 90	6 79	0 10	O F	O F
14	16 07	10 75	8 76	7 66	4 93	0 08	O F	O F
15	14 43	12 57	9 06	7 15	5 54	0 13	O F	O F
16	14 35	8 51	5 22	3 81	2 66	0 97	O O	O F
17	16 16	9 58	6 89	4 98	3 23	0 00	O F	O F
18	15 89	11 74	9 25	8 04	6 02	1 89	O O.	O F
19	18 36	10 97	8 85	8 06	6 48	0 09	O F	O F
20	14 08	12 83	10 95	9 11	6 83	0 00	O F	O F
21	15 01	9 90	7 81	5 98	4 89	0 50	O F	O F
22	13 64	10 68	7 66	6 11	4 88	0 07	O F	O F
23	13 30	7 90	5 04	4 20	1 20	0 00	O F	O F
24	15 82	9 46	5 06	4 68	2 64	0 18	O F (S O F)	O F
25	15 63	10 77	7 88	4 57	3 70	0 10	O F	O F
26	14 46	11 08	7 95	5 56	4 13	0 09	O F	O F
27	14 89	9 14	7 29	6 40	2 79	0 07	O F	O F
28	10 90	8 35	6 38	5 30	2 40	0 00	O F	O F

O F — Over-fired. S.O F — Slightly over-fired.

Table II, when considered with reference to Fig. 1, indicates that all the three fluxes, when used individually, are suitable for the production of earthenware and semi-vitreous bodies The absorption figures of bodies 1, 23 and 28 at cones 9, 10 and 12 show that at these temperatures calcium-zirconium silicate is more effective as a flux than the other two It is also clear that for any temperature below the point of vitrification, a combination of whiting and calcium-zirconium silicate or of wollastonite and calcium-zirconium silicate yields a considerably greater fired density than a combination of whiting and wollastonite. The increased activity of calcium-zirconium silicate is further evidenced by the temperature vs absorption data for the bodies 4, 7, 12, 20 and 28 on the one hand and 3, 6, 9, 10, 11, 13, 14, 15, 17, 18, 19, 21 and 22 on the other The gradual increase in the proportion of calcium-zirconium silicate in the body results in increased fired density

Fig 2 shows the progress of vitrification of the three end members of the series and curve A shows that at low temperatures whiting bodies are somewhat more porous than the other two, this is evidently due to the evolution of CO_2 from whiting in the earlier stages of firing It is further evident that whiting is not a suitable flux for vitreous (0-0·5 per cent absorption) bodies, or earthenware bodies in the region of 10-12 per cent absorption, even though it may be satisfactorily used for porous bodies in the region of 15-18 per cent absorption, or semi-vitreous bodies in the region of 0 5-7 per cent absorption Curve B similarly indicates that calcium-zirconium silicate is not suitable in the region of 0-0·5 per cent, 5-10 per cent or 10-12 per cent absorption, while curve C indicates the suitability of wollastonite for earthenware (10-12 per cent) and semi-vitreous (5-7 per cent) bodies The typical one cone (Orton) vitrification range for vitreous bodies was observed in each case



A, 1 whiting, B, 23 Ca-Zr silicate, C, 28 wollastonite

FIG 2 — FIRING CURVES FOR BODY NOS. 1, 23 AND 28

Effect of Flux Selection on Fired Properties — Data presented in Table III show that all the three representative bodies were markedly deficient in fired transverse strength as compared to 20,000-25,000 p s i. for commercial zircon porcelains which is possibly due to the dry-press method of forming A later study by the author (to be published later) revealed that the conventional wet processes of fabrication including casting and extrusion highly improved the transverse strength

TABLE III — EFFECT OF FLUX SELECTION ON FIRED PROPERTIES OF PORCELAIN BODIES*

	Body No		
	1	23	28
1 Firing cone	13^{6}	13^{6}	13^{6}
2. Per cent fired absorption	0 071	0 078	0 010
3. Fired transverse strength in lb. per sq inch	14566	13570	14806
4 Bulk specific gravity	3 56	3 65	3 62
5. Apparent specific gravity	3 60	3 67	3 63
6. Per cent total shrinkage	12 52	13 71	10 05
7 Fired warpage represented in inch per inch	0 091	0 063	0 086
8. Translucency in inches	0 148	0 169	0 125
9 Coefficient of thermal expansion × 10^{-6}	4 83	4 91	4 89

* Body No. 1 — using whiting as the flux.
Body No. 23 — using calcium zirconium silicate as the flux.
Body No. 28 — using wollastonite as the flux.

It is quite possible that the other properties studied here are also affected by the method of forming, but to a lesser degree.

With the exception of colour, the effect upon the fired properties is almost the same for all the three fluxes The fired colour was white for body 23, light cream for 28 and dark cream for 1 Depending upon the usage of the finished product, the differences in the fired colour might be important in the selection of the flux.

Effect of Different Pressing Techniques & Forming Pressures — This phase of the study was initiated because previous experience of the author indicated that friction of the die at the edges of the specimens resulted in somewhat local porosity It was, therefore, expected that pre-densing at the edges of the pressing batch and/or the application of two or more pressure cycles might give uniformity in the density of the fired bodies Table IV shows that an increase in forming pressure up to 6,000 p s i results in gradually decreased porosity This effect is, however, relatively slight for the increase from 3,000 to 4,000 p s i but quite appreciable for increases from 4,000 to 5,000 and 5,000 to 6,000 p s i There appears to be no advantage in increasing the pressure beyond 6,000 p s.i It is also interesting to note that the forming pressure rather than the pressing technique is important in the control of fired density Pre-densing at the edges of the pressing batch, which would normally be expected to be beneficial apparently, had no significant effect.

TABLE IV — EFFECT OF DIFFERENT PRESSING TECHNIQUES & FORMING PRESSURES ON FIRED ABSORPTION

(*Body No. 23 — dry-pressed, cone 12°*)

FORMING PRESSURE (p.s.i)	EDGES OF SPECIMENS PRE DENSED BEFORE PRESSING	NO. OF PRESSURE CYCLES	FIRED ABSORPTION, %
3000	No	Single	1 65
3000	No	Double	1 45
3000	No	Triple	1 58
3000	No	3 cycles*	1 58
3000	Yes	Single	1 68
3000	Yes	Double	1 32
3000	Yes	Triple	1 57
3000	Yes	3 cycles*	1 97
4000	No	Single	1 31
4000	No	Double	1 29
4000	No	Triple	1 29
4000	No	3 cycles*	1 09
4000	Yes	Single	1 51
4000	Yes	Double	0 95
4000	Yes	Triple	1 25
4000	Yes	3 cycles*	1 36
5000	Yes	Single	1 30
5000	Yes	Double	0 81
5000	Yes	Triple	0 92
5000	Yes	3 cycles*	1 07
5000	No	Single	0 92
5000	No	Double	0 68
5000	No	Triple	0 96
5000	No	3 cycles*	1 10
6000	No	Single	0 57
6000	No	Double	0 57
6000	No.	Triple	0 40
6000	No	3 cycles*	0 55
7000	No	Single	0 76
7000	No	Double	0 48
7000	No	Triple	0 20
7000	No	3 cycles*	0 47

* A multi-stage cycle employing three pressure applications of increasing intensity was used.

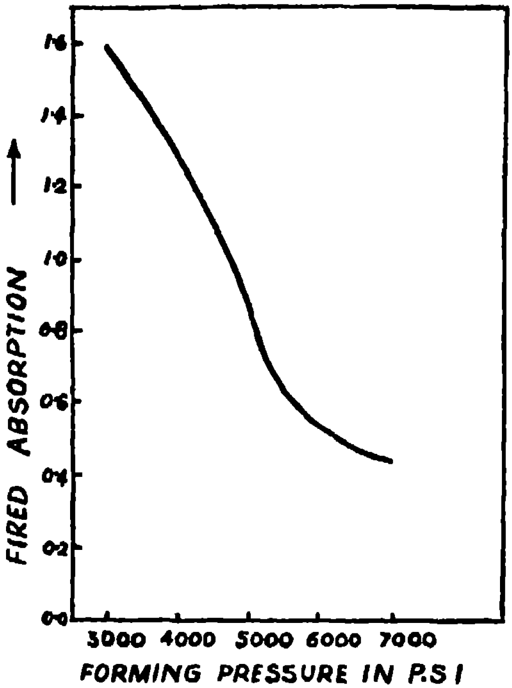


FIG 3 — EFFECT OF FORMING PRESSURE ON FIRED ABSORPTION, BODY No 23, DRY PRESSED, CONE 12°

Conclusions

Lime (CaO) is a useful flux in zircon porcelain bodies whether it is added as calcium zirconium silicate, as whiting or as wollastonite As regards the maturing range, however, none of the fluxes are of any outstanding merit for the development of vitreous zircon porcelains processed by the dry-press method The effect of flux selection is more pronounced in porous rather than in vitrified bodies Calcium-zirconium silicate is more effective as a flux than whiting or wollastonite These fluxes are more effective individually than in combinations

In the dry-press method of forming, an increase in forming pressure results 'in decreased porosity (the optimum effect being obtained at 6,000 p s i) The forming pressure rather than the pressing technique is important in the control of fired density.

But for the fired colour, flux selection has no appreciable effect upon the fired properties of zircon porcelains.

Compared to commercial zircon porcelains, these bodies were markedly deficient in transverse strength This deficiency has been attributed mainly to the method of forming

Acknowledgement

The author wishes to express his grateful appreciation to Dr R Russell, Jr, Department of Ceramic Engineering, Ohio State University, under whose direction and guidance this investigation was made

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Letters to the Editor

SEARCH FOR MICROFOSSILS IN THE NEOBOLUS SHALES OF THE SALT RANGE, PUNJAB

PROF B. SAHNI AND HIS COLLABORATORS have found remains of vascular plants in the rock samples of the Saline Series and on this evidence have assigned to it an Eocene age This observation has been confirmed by A K Ghosh[1] and his co-workers at Calcutta Ghosh and his associates have also examined beds overlying the Saline Series for microfossils Strangely enough they have discovered in all these beds microfossils of the same general nature as from the Saline Series They have macerated one sample of the Neobolus Shales and from it reported "numerous pieces of wood often with uni- to multi-seriate bordered pits and a round pitted spore with triradiate scar" The Neobolus Shales are acknowledged to be definitely Cambrian The finding of remains of vascular plants in them is most unexpected, for the earliest land plants are universally believed to have first appeared only in the Middle Silurian With a view to confirm these interesting discoveries I examined two samples of Neobolus Shales

The samples are registered as *S* 83 and 36/547. Sample *S* 83 is a dark grey micaceous shale on the surface of which is visible an impression of a Neobolus shell. It was collected by Prof Sahni from Khewra in 1945 36/547 is a grey micaceous shale with a light chocolate hue It was collected from "north of Rawal, Eastern Salt Range, Punjab". This sample was kindly given to me for examination by the Geological Survey of India

About 50 gm of each sample were broken to small pieces, brushed and, after passing through a flame, dropped separately in about 100 c c of filtered commercial nitric acid. After a week, the acid was decanted off and some filtered distilled water was added to the settled rock material The material was then lightly shaken so that while the heavy rock particles remained at the bottom, the lighter ones along with the organic remains, if any, may float upwards The muddy solution containing the lighter portion was poured into another vessel and left for settling. The clear liquid was decanted off and the sediment was washed free of any traces of acid by filtered water The residue was left in aqueous ammonia overnight, after which the alkali was washed off. It was then treated with hydrofluoric acid to dissolve the silica. After washing out the acid, the residue was treated with caustic soda solution. Thus as much of the rock matter as possible was eliminated before examining the residue for microfossils. After washing, the residue was transferred to a watch glass and given a light rhythmic shake so that the possible organic remains may migrate towards the centre In this way the clearer portion was separated from the heavier one containing the greater part of the organic matter To ensure that no organic remains escaped notice, both portions were examined

No microfossils were found in 36/547 In *S* 83 two tiny objects of a doubtful nature were noted, but they do not seem to represent any plant structure The first is a small flake-like object with a large number of small specks on the surface The other looks like a membrane folded into an irregular shape My examination of the Neobolus Shales has failed to reveal any recognizable plant remains. There is, therefore, no evidence available at present on the strength of which the already established Cambrian age of the Neobolus Shales can be questioned

I am grateful to Prof T M. Harris, F R S, for the improved maceration technique employed in this work

R N LAKHANPAL
Birbal Sahni Institute of Palaeobotany
Lucknow
July 26, 1950

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INVESTIGATIONS ON THE PREPARATION, PROPERTIES & NUTRITIVE VALUE OF RICE SUBSTITUTES FROM TUBERS & MILLETS

CONSEQUENT ON THE PRESENT SHORTAGE OF rice and other staple foods, it has become increasingly necessary to make up the deficit through other sources Among these, the most promising are tubers, e.g tapioca and sweet potato, which can be produced more abundantly than cereals Tapioca and sweet potato are deficient in proteins and are, therefore, by themselves, poor substitutes for cereals In an earlier paper[1] from this laboratory it has been shown that incorporation of groundnut cake flour to the extent of 20 per cent with tuber flours makes up for the deficiencies of the latter and the nutritive value of a mixture of tapioca flour (80 parts) and groundnut cake flour (20 parts) is superior to that of rice More recent investigations (unpublished) have shown that the replacement of 25 per cent of rice or wheat by tapioca or sweet potato flour does not lead to any deterioration in the overall nutritive value of poor rice or wheat diets, as judged by the rate of growth of young rats

In suggesting alternate food substitutes for rice, we have to take into consideration not only their nutritive value but also their acceptability from the psychological point of view Food in the form of flour, though readily acceptable to wheat and millet eaters, is not psychologically acceptable to rice eaters accustomed to eating food in the shape of grains Investigations were, therefore, undertaken to explore the possibility of preparing rice substitutes from tapioca (with and without the addition of groundnut cake flour) and also from millets.

The possibility of preparing rice-like grains from various sources has been investigated by a number of previous workers. Particular reference may be made to the pioneering work of Bhatnagar and his associates who produced rice-like grains from broken rice (private communication) More recently, rice-like grains have been produced in other countries from wheat flour which were used as substitutes for rice during the last war. Tuber flours have not, however, so far been used for such a purpose because of certain practical difficulties. Millets offer more scope in this direction.

For the processing of maize, the grain is first steeped in water containing a trace of sulphur dioxide (0 02 per cent) for two days till the skin is softened. It is then washed and crushed with addition of fresh water The resulting paste is passed through fine sieves to separate the skin from starch and protein The mixture of the latter could be used as such or sent over tables so as to separate as much of the gluten as possible if a white product is desired Groundnut cake flour (10 per cent) and dicalcium phosphate (0·5 per cent) are then added to provide extra protein, B vitamins and minerals Sufficient water (one and a half times the weight of the mixture) is added and the mixture cooked to a thick pasty mass This is then pressed through a perforated disc into strands of about the same thickness as rice. These strands are partially dried in the sun or in a drier at about 45°-50°C. and cut mechanically into small pieces of the same size as natural rice grain and finally dried completely.

For the processing of a mixture of tapioca flour and groundnut cake flour, the following method which is similar to that employed commercially for the manufacture of sago from tapioca starch is adopted The method of pre-cooking does not work satisfactorily in the case of tapioca

Tapioca flour or a mixture of tapioca flour with groundnut cake flour or jowar (*Sorghum vulgare*) flour is moistened with water (about 50 c c water being added to 100 gm of the mixture) The moist flour is granulated by passing it through a wire-mesh (6-8 to an inch) and then shaken in trays with a cloth bottom for 20-30 min, when the flour is converted into round grains The wet grains are roasted in a metallic vessel with a trace of deodorized hydrogenated oil over an electric heater until the grains gelatinize and harden The roasted grains are finally dried in the sun or in a drier at 50°-55°C.

The appearance and cooking quality of different samples of rice substitutes are given in Table I

TABLE I

SAMPLE No.	COMPOSITION	APPEARANCE	APPEARANCE & TASTE OF THE COOKED PRODUCT
1	Maize starch, 89 parts + groundnut cake flour, 10 parts + salt mixture (Steenbock), 1 part	Dull white	The cooked product has a dull white appearance, acceptable taste
2	Maize flour (dehusked), 89 parts + groundnut cake flour, 10 parts + salt mixture (Steenbock), 1 part	Light yellow	The cooked product has a light-yellow colour, acceptable taste
3	Tapioca flour, 99 5 parts + dicalcium phosphate, 0 5 part	Dull white	Cooks to a pasty mass similar to sago, taste, good
4	Tapioca flour, 89 5 parts + groundnut cake flour, 10 parts + dicalcium phosphate, 0 5 part	Light brown	Cooked product rather pasty, taste, good
5	Tapioca flour, 69 5 parts + jowar flour, 25 parts + groundnut cake flour, 5 parts + dicalcium phosphate, 0 5 part	Light brown	Cooks like unpolished rice, the cooked grains remaining separate from one another
6	Tapioca flour, 70 parts + groundnut cake flour, 20 parts + broken rice, 10 parts	do	Cooked product rather pasty, taste, good
7	Tapioca flour, 70 parts + groundnut cake flour, 20 parts + wheat, 10 parts	do	do

From the data given in Table I, it will be evident that the cooking quality of the rice substitutes prepared from maize and also from a mixture of tapioca, jowar and groundnut cake flour (No 5) is better than that of rice substitutes prepared from tapioca flour and groundnut cake flour. This is due to the fact that the cereal starch, on cooking, sets to an opaque jelly, whereas the tuber starch sets to a glassy and pasty mass. Further experiments were, therefore, carried out to improve the cooking quality of tapioca flour and starch.

Schoch[8] ascribed the difference in the cooking quality between cereal and tuber starches to the presence of polar fatty acids in the latter. He reported that after the removal of fatty acids from maize starch and rice starch by solvent extraction, the fat-free starches on cooking gave more transparent and glutinous gels than untreated starches. In view of the above findings, the effect of incorporation of certain higher fatty acids, viz. stearic, palmitic and oleic acids, on the cooking quality of rice substitutes prepared from tapioca flour and sago from tapioca starch was studied The results showed that the incorporation of higher fatty acids at 1 per cent level definitely improved the cooking quality, the cooked product appearing opaque and less pasty The cooked products had an agreeable flavour and taste.

The nutritive value of two of the rice substitutes (Nos 6 and 7 in TABLE I), as compared to rice, was determined by the rat-growth method Groups of young rats, about 4 weeks old and weighing 45-50 gm. (8 in each group), were fed for a period of 8 weeks on three different diets, one based on rice and the other two diets based on rice substitutes (Nos 6 and 7) The other constituents were the same in all the three diets The results are given in Table II

TABLE II — AVERAGE WEEKLY INCREASE IN BODY WEIGHT OF YOUNG RATS FED ON DIFFERENT DIETS FOR A PERIOD OF 8 WEEKS

DIET No.	QUANTITY OF RICE OR RICE SUBSTITUTES IN THE DIET*	AVERAGE INITIAL BODY WT, gm.	AVERAGE FINAL BODY WT., gm.	AVERAGE WEEKLY INCREASE IN BODY WT gm.
1	Raw milled rice (78 5%)	50 2	81 5	3 9±0 2
2	Rice substitute No. 6 (78 5%)	49	110	7 6±0 5
3	Rice substitute No. 7 (78 5%)	49	105	7 0±0 37

*All the diets contained the same quantity of other foods, viz. red gram, 5 0 per cent, non leafy vegetables (brinjal, potato and raw plantain), 5 2 per cent, leafy vegetables (amaranth, cabbage, etc.), 2 1 per cent; crude groundnut oil, 5 0 per cent, milk powder, 0 9 per cent; and common salt, 0 2 per cent.

It will be seen from Table II that rice substitutes prepared from a mixture of tapioca flour (70 parts), groundnut cake flour (20 parts) and rice or wheat (10 parts) possess a higher nutritive value than rice.

A study of the nutritive value of other rice substitutes and also the effect of incorporation of fatty acids on the nutritive value and availability of calcium and phosphorus present in them is in progress

The present investigation has shown that it is possible to prepare substitute grains from maize and tapioca flour which can be used as partial substitutes for rice Even though the products obtained from a mixture of tapioca flour and groundnut cake flour have a light-brown colour, still the cooked products are quite palatable They could be cooked either as such or admixed with rice Consumer trials carried out with different food preparations made out of the rice substitutes showed that they were generally acceptable

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SPREADING OF HIGH POLYMERS: COPOLYMER OF STYRENE & METHYLMETHACRYLATE

A study of the spreading properties of high polymers is of interest and is likely to provide information on the relationship between spreading property and molecular structure The results of our work on the spreading properties of a copolymer of styrene and methylmethacrylate are recorded here

The surface films were studied by means of a surface pressure balance improvised from a du Nuoy tensiometer[1] The copolymer studied consists of 70 per cent styrene and 30 per cent methylmethacrylate and was kindly supplied by Prof S R Palit, *Indian Association for the Cultivation of Science*, Calcutta The solutions for spreading were prepared in freshly distilled benzene, the purity of which was tested by spreading The results of spreading two solutions of the copolymer, viz 0·2 per cent and 0·018 per cent, are represented in Fig. 1.

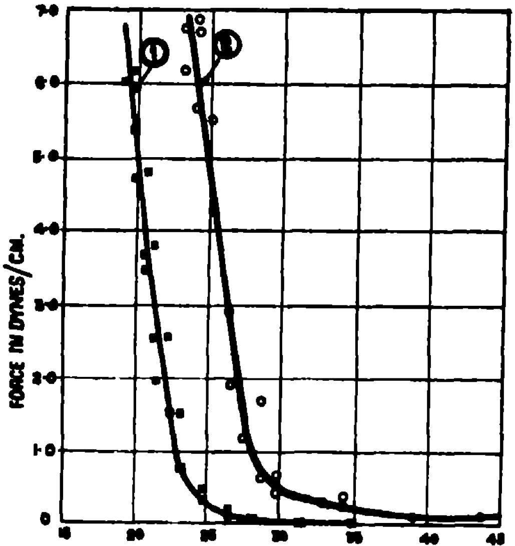

Fig 1 — Spreading of copolymer of styrene and methylmethacrylate, (1) 0 2 per cent solution, (2) 0 018 per cent solution

The limiting area per group should, normally, be independent of the concentration of the solution used for spreading In the present instance, however, it is found that the extent of spreading depends upon the concentration of the solution The limiting area per group changes from 28 5 sq Å with 0 2 per cent solution, to 23 5 sq Å with 0·018 per cent solution This phenomenon cannot be explained on the basis of too rapid evaporation giving the polymer molecules insufficient time to orientate into the monolayer, for, tolerably consistent results have been repeatedly obtained for specific areas in independent experiments in which this time factor was by no means constant. The results appear to indicate that polymers in high concentration solutions have a felt-like structure

Further work on the spreading behaviour of high polymers in solutions of different concentrations is in progress

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July 25, 1950

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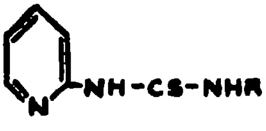
GUANIDINES, THIOUREAS & BIGUANIDES OF 2-AMINOPYRIDINE

COMPOUNDS OF THE PYRIDINE NUCLEUS which may be regarded as the heterocyclic fragment of the molecules of plasmochin and mepacrin have recently been investigated by several authors[1,2] Schonhofer[3] suggested that the anti-malarial action of mepacrin is connected with the possibility of tautomerism Curd Rose and Davey[4] have supported this theory in connection with paludrine 2 or 4-aminopyridine exhibits tautomerism similar to mepacrin It was therefore considered desirable to synthesize a series of substituted 2-aminopyridines (types A, B and C) and to investigate their anti-malarial properties

The method used for the synthesis of guanido-derivatives of 2 aminopyridine (type B) consisted in the desulphurization of pyridylthioureas with alcoholic ammonia and mercuric oxide[5-7] at room temperature for 12 hr followed by refluxing on a water bath for half an hour Pyridylthioureas (type A) were prepared by refluxing 2-aminopyridine in alcoholic solution with the appropriate mustard oil Pyridylbiguanides (type C) were synthesized by fusing 2-aminopyridine hydrochloride with the appropriate cyano-guanidines

The properties and analyses of compounds are recorded in Table I

The compounds are being examined for anti-malarial activity Full details will be published later



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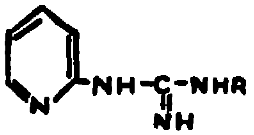

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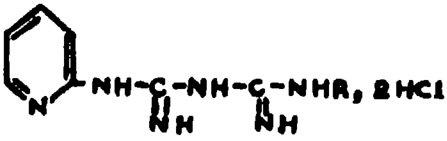

TYPE C

TABLE I

No	Substituent	Type of the compound	M P C	Formula	Found N %	Required N %
1	$\begin{matrix}CH_3\\CH_3\end{matrix}>CH$	A	129 30	$C_9H_{13}N_3S$	21 55	21 53
2	$CH_2=CH-CH_2$	A	100 1	$C_9H_{11}N_3S$	21 65	21 75
3	C_6H_5	A	167	$C_{12}H_{11}N_3S$	18 25	18 33
4	m $CH_3\ C_6H_4$	A	168 70	$C_{13}H_{13}N_3S$	17 01	17 28
5	P $CH_3\ C_6H_4$	A	182	$C_{13}H_{13}N_3S$	16 96	17 28
6	p-Cl C_6H_4	A	188	$C_{12}H_{10}ClN_3S$	15 95	15 99
7	$\begin{matrix}CH_3\\CH_3\end{matrix}>CH$	B	82	$C_9H_{14}N_4$	31 01	31 46
8	$\begin{matrix}CH_3\ CH_2\\CH_3\text{——}\end{matrix}>CH$	B	80 81	$C_{10}H_{16}N_4$	29 06	29 16
9	$CH_2\ CH\ CH_2$	B	68 65	$C_9H_{12}N_4$	31 50	31 81
10	C_6H_5	B	108 9	$C_{12}H_{12}N_4$	26 40	26 41
11	m $CH_3\ C_6H_4$	B	134 35	$C_{13}H_{14}N_4$	24 50	24 77
12	p-$CH_3\ C_6H_4$	B	148	$C_{13}H_{14}N_4$	24 61	24 77
13	p Cl C_6H_4	B	175 76	$C_{12}H_{11}ClN_4$	22 57	22 76
14	H	C	272 with previous shrinking	$C_7H_{10}N_6$, 2HCl	33 50	33 60
15	p Cl C_6H_4	C	212 15(d)	$C_{13}H_{13}ClN_6$, 2HCl	23 23	23 23
16	p-Br C_6H_4	C	210 2(d)	$C_{13}H_{13}BrN_6$, 2HCl	20 71	20 74

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Bangalore May 1950

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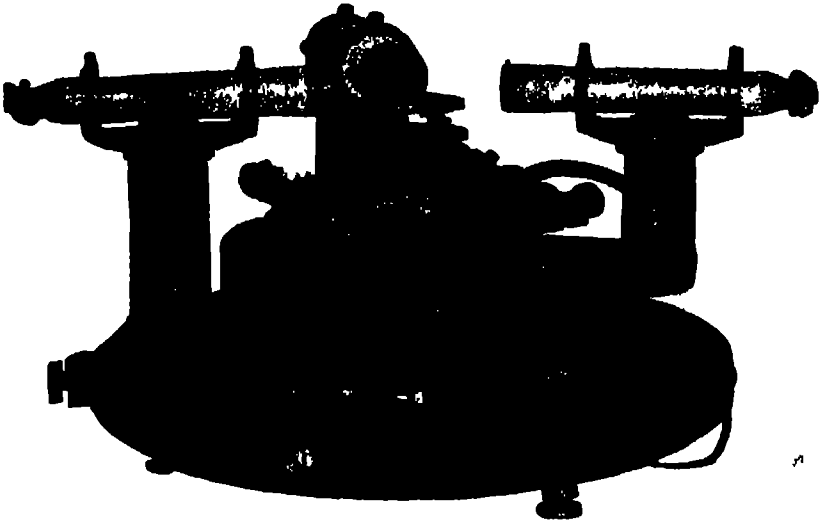

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2 1 NOV 1950

A Study of Forbidden Lines in the L-Spectrum of Platinum

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A detailed study of the forbidden lines in the L-spectrum of platinum have been made Two new lines λ 1386 6 and λ 1110 6 corresponding to transitions $L_{III}M_{III}$ and $L_{II}M_V$ have been discovered Three non quadrupole lines λ 1182 λ 943 3 and λ 897 9 corresponding to transitions L_IM_I L_IN_I and L_IO_I have been reported for the first time on a plane crystal spectrograph

SEVERAL investigators have reported the existence of faint lines in X ray emission spectra These lines cannot be explained as normal dipole transitions for which the selection rules derived from theory allow transitions between those energy states only for which $\Delta l = \pm 1$ $\Delta j = 0 \ \pm 1$ except $j = 0$ to $j = 0$ Such faint lines are of two classes

(1) Forbidden lines which fit into the energy level schemes but involve transitions violating the dipole selection rules and

(2) those lines which have no place in the energy level schemes known variously as non diagram lines satellites or spark lines

This paper gives an experimental report on the faint lines of the former type i e forbidden lines in the L spectrum of platinum

The platinum L spectrum has been studied by Moseley Siegbahn Coster Dauvillier Rogers Lang Friman Weber Idei[1] Kaufman[2] and Y Cauchois[3] Amongst the earlier workers a few forbidden lines were reported by Dauvillier Rogers and Idei Later in a systematic work on the faint lines of several elements of high atomic number Kaufman reported as many as 11 forbidden lines in the L spectrum of platinum Some of these lines were confirmed and some more forbidden lines were obtained by Y Cauchois working on the curved crystal focussing spectrograph An examination of the data of the previous workers revealed several inconsistencies and it was considered worth while to make a detailed study of these forbidden lines in this laboratory

Experimental

The spectrograph used was a single crystal instrument of fairly good dispersion made by Messrs Adam Hilger of London A well tried crystal of calcite was used for this investigation The X ray tube was of Siegbahn demountable gas type with separate water cooling arrangements for the cathode and anti cathode The target consisted of a sheet of pure platinum The high tension equipment consisted of a transformer with a mechanical rectifier The voltage applied was between 40 and 50 kV the tube current being about 6 m a throughout this investigation Several plates were taken for which exposures up to 250 milliamp hr were given Measurements were however made on only three plates which were quite satisfactory exposure times being 10 20 and 30 hr All measurements were made with reference to the Pt $L\alpha_1$ $L\beta_1$ $L\gamma_1$ and Cu $K\alpha_1$ lines For the Pt $L\alpha_1$ $L\beta_1$ $L\gamma_1$ lines the values given by Friman ($L\alpha_1$ = 1310 33 $L\beta_1$ = 1117 58 $L\gamma_1$ = 955 99 X U) were taken and for the Cu $K\alpha_1$ the value 1537 396 X U recommended by Siegbahn[4] was used One of the spectrograms is shown in the figure

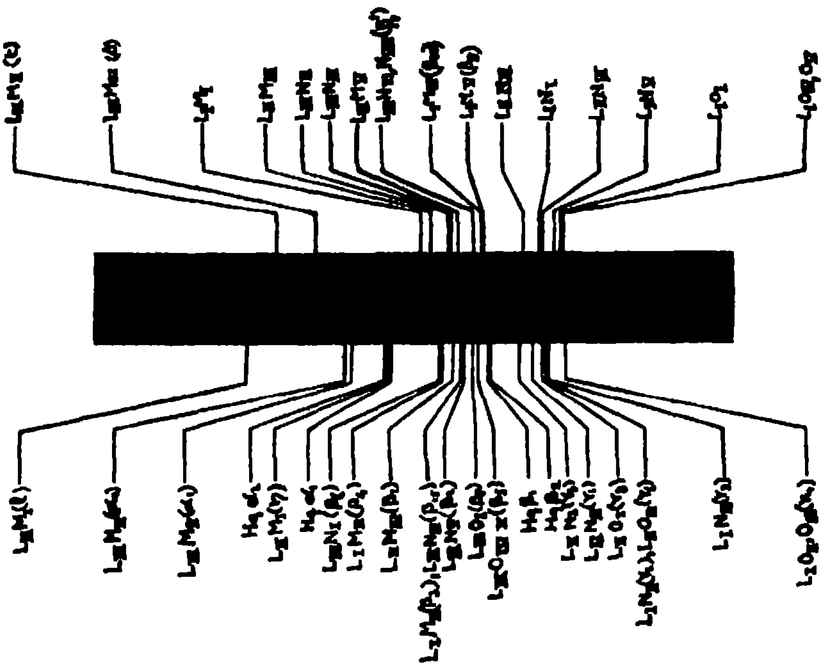

FIG 1 — THE L-SPECTRUM OF PLATINUM THE POSITIONS OF THE VARIOUS FORBIDDEN LINES ARE SHOWN ON THE TOP SIDE AND THE ALLOWED TRANSITIONS ON THE BOTTOM SIDE THE LINES ARE DUE TO THE MERCURY DIFFUSION PUMP WHICH WAS USED FOR EVACUATING THE X-RAY TUBE

Table I gives the forbidden lines which can be classified as quadrupole transitions, for which the selection rules are $\Delta l = 0, \pm 1, \pm 2$ except $l = 0$ to $l = 0$, and $\Delta j = 0, \pm 1, \pm 2$ except $j = 0$ to $j = 0$ and $j = \frac{1}{2}$ to $j = \frac{1}{2}$

Table II gives those forbidden lines which cannot be explained as quadrupole transitions.

Discussion

1 λ 1386 6 ($L_{III}M_{III}$) and λ 1110·6 ($L_{II}M_{V}$)— These investigations have revealed

TABLE I — QUADRUPOLE LINES

TRANSITION	NAME OF THE LINE	Δl	Δj	WAVELENGTHS IN X.U * Deauvillier	Rogers	Idei	Kaufman	Y Cauchois	Authors	REMARKS	
L_I M_{IV}	β_{10}	−2	−1	1059 3	1066 0		1059 4	1059 73	1059 0	Faint	Sharp
L_I M_V	β_9	−2	−2	1052 4	1059 9	1052 4	1051 9	1052 86	1052 5	Faint	Sharp
L_I N_V		−2	−2	912 0			912 2		912 5	Faint	Sharp
L_I O_{IV} L_I O_V		−2 −2	−1 −2				891 4	892 5 891 6	891 9	Faint	Sharp
L_{II} M_{III}		0	−1				1164 7	1164 5	1164 2	Faint	Broad
L_{II} M_V		−1	−2						1110 6	Very faint	Sharp
L_{II} N_{III}		0	−1				969 9	969 78	969 5	Very faint	Sharp
L_{II} N_{VI}		−2	−2				967 2	967 46	967 2	Faint	Sharp
L_{III} M_{II}	t	0	+1	1449 0				.	1450 0	Faint	Broad
L_{III} M_{III}	s	0	0					..	1386 6	Faint	Sharp
L_{III} N_{II}		0	+1				1129 1		1128 4	Faint	Sharp
L_{III} N_{III}		0	0				1120 1	.	1120·4	Faint	Sharp
L_{III} N_{VI} L_{III} N_{VII}	β'_7	−2 −2	−1 −2			1076 9	1076 2	1076 74	1077 5	Faint	Sharp
L_{III} O_{II} L_{III} O_{III}		0 0	+1 0		..		1073 9	..	...	......	

* All the values are in X-units. No conversion factor has been applied as recommended by Wood[6] for the facility of comparison with the data of other workers.

TABLE II — NON QUADRUPOLE LINES

TRANSITION	NAME OF THE LINE	Δl	Δj	WAVE LENGTHS IN X U* Dauvillier	Rogers	Idei	Kaufman	Y Cauchois	Authors	REMARKS	
$L_I M_I$		0	0					1175	1182	Faint	Broad
$L_I N_I$		0	0					943 7	943 3	Very fa nt	Sharp
$L\ O_I$		0	0					897 8	897 9	Very faint	Sharp
$L_{II} N_{II}$		0	0					980 5			

*All the values are in X units No conversion factor has been appl ed as recommended by Wood[5] for the facility of comparison with the data of other workers.

the existence of these two new lines which are here reported for the first time The line $L_{III}M_{III}$ is fairly strong and was measured on plate I It is interesting to note that this transition (L_{III} M_{III}) was found by Dauvillier for 77 Ir and 79 Au and by Woodall[6] for 79 Au The line L_{II} M_v though very faint has been found on plates I and II so that there seems to be no doubt about its existence

2 λ 1073 9 (L_{III} $O_{II\ III}$) and λ 980 5 ($L_{II}N_{II}$)— The line $L_{III}O_{II\ III}$ has been reported so far by Kaufman alone In spite of many attempts the authors could not find even the slightest trace of this line The existence of this line seems therefore to be rather doubtful

The non quadrupole line $L_{II}N_{II}$ has so far been reported only by Cauchois In spite of several attempts the authors could not find the slightest trace of this line Since Cauchois used a curved crystal spectrograph it might have been possible to find a trace of this line in her work But since as Cauchois reports the line is comparatively feeble it is extremely difficult to distinguish it from the background blackening on such plates as obtained by the authors on a plane crystal spectrograph

3 λ 1450 (L_{III} M_{II}) — Among the previous workers this line has been reported by Dauvillier alone We found a faint trace of this line on plate III

4 λ 1182 (L_I M_I) — This transition was reported for the first time by Cauchois The authors have found this transition but the line is rather broad and the value is somewhat higher

5 λ 892 5 (L_I O_{IV}) and λ 891 6 (L_IO_V)— These transitions which have a separation of 0 9 X U were resolved by Cauchois on the curved crystal spectrograph It has not been possible for any of the other workers to resolve these transitions

6 λ 943 3 (L_IN_I) and λ 897 9 (L_IO_I)— These non quadrupole transitions were reported by Cauchois for the first time for platinum Kaufman has found the L_I N_I line for 77 Ir 79 Au 81 Tl 82 Pb and 83 Bi but could not observe it in the platinum spectrum Kaufman also found the L_I O_I line for 73 Ta 77 Ir 81 Tl 82 Pb and 83 Bi but could not find it for platinum These lines have been observed by the authors for the first time on a plane crystal spectrograph

7 Lastly it is worth noting that so far none of the workers have found any forbidden line for which either Δl or Δj is three

Acknowledgement

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Purification of Carbon Rod by Resistance Heating

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Carbon rod, employed as an electrode in the cathode layer arc for spectrum analysis, has been purified by passing a current of 570 amp. (maximum) for 90 sec. through the rod (10 cm. length, 7 mm. dia.) in an atmosphere of nitrogen-chlorine mixture. The purified rod contains traces of boron.

MOST of the impurities in carbon rod may be removed by volatilization at very high temperature, beyond 2,500°C The method of resistance heating was employed by Russanow, Preuss, Gatterer, Trombe, Foex, Bardet and Hoogland for the purification of carbon rods to be used as electrodes Hoogland[1] purified carbon rods (length 20 cm, dia. 7 mm.) by the method of resistance heating ($i_{max.} = 650$ amp. for 60 sec in air) and the purified rods were analysed by the cathode layer method with an arc current of 5 5 amp. at 220 V D C In the purified rods, the following impurities were still present the original amount of boron, traces of iron, magnesium, calcium, and traces of tin and copper.

In my previous investigation[2] the method of resistance heating was employed for the purification of "Kino-Homogen" (German) carbon rods ($i_{max} = 550$ amp. for 50 sec in air) The following impurities were present in the original carbon rod iron, boron, silicon, copper, nickel, titanium, aluminium, magnesium, sodium, calcium and manganese in large amounts and silver, vanadium, zinc, bismuth, cadmium, tin, gallium, lead, chromium, arsenic, potassium and cobalt in small traces. The purified rod was analysed by the cathode layer method with an arc current of 11 amp at 220 volts and the purification was more or less the same for most of the elements as that obtained by Hoogland. For copper Hoogland's purification was better. For boron the purification was unsatisfactory as was also found by Hoogland The object of the present investigation was to study the method of resistance heating in an atmosphere of N_2-Cl_2 mixture.

Experimental

The holders, for the carbon rod to be fastened horizontally, consisted of two graphite rods (each 13 cm. length, 4·5 cm dia) Both the graphite rods were drilled at the centre at one end (2 cm depth, 6 5 mm dia.) and cut into equal halves through it The carbon rod (10 cm. length, 7 mm dia.) was clamped tightly at both ends (1 cm. being introduced at the ends) into the holes of the graphite holders by means of thick metal strips screwed round the holders at the remote ends These graphite holders were fitted tightly inside a pyrex glass chamber (10 cm. dia, 24 cm. length) through openings of the side metal plates. Thick asbestos sheets were placed in between the metal plates and the sides of the glass chamber which were also clamped by means of screw arrangements with proper insulation of mica tubes. The chamber was evacuated by a Cenco pump connected to a side tube of the metal plate. Nitrogen from a cylinder was bubbled through carbon tetrachloride and then introduced into the chamber through the other side tube. The graphite rods were connected to the secondary terminals of a special transformer (primary voltage 220V., secondary voltage 24). An ammeter (0-100 A) was inserted in the primary circuit. All the contacts

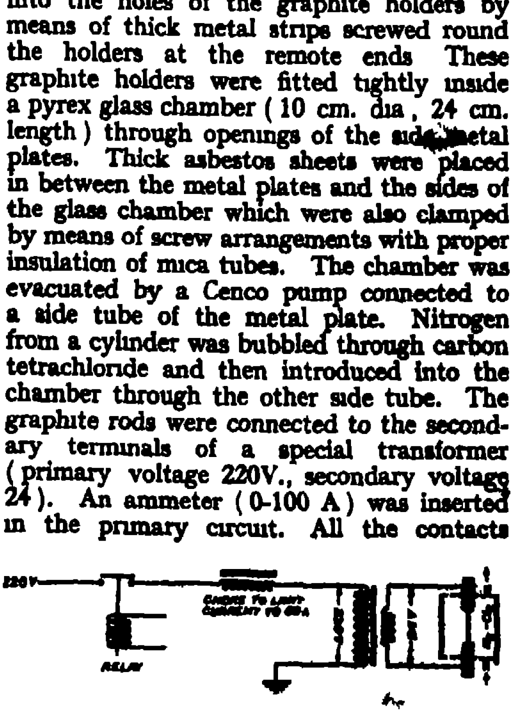

FIG 1 — ELECTRICAL CONNECTIONS AND OTHER ARRANGEMENTS FOR RESISTANCE HEATING

between the carbon rod and the graphite holders and the electrical connections to the graphite rods were good enough to minimize the high transition resistances Fig 1 shows the arrangement for resistance heating.

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The carbon rod was chemically treated according to the previous method[8] and then dried in an electric furnace at 500°C. This rod was fitted in the graphite holders inside the glass chamber and was heated by allowing a current of 570 amp maximum (limited by choke) to pass through it for 90 sec in an atmosphere of N_2-Cl_2 mixture A continuous current of nitrogen bubbled through carbon tetrachloride was passed through the chamber. The behaviour of the current recorded by the ammeter in the primary circuit is represented in Fig 2 The length of the carbon rod being only 8 cm, the sag of the rod was almost negligible.

The resistance heated carbon rod was cut into equal halves and then analysed by the cathode layer method with an arc current of 11 amp at 220 volts d c. (time of exposure 1 min). The results are recorded in Table I

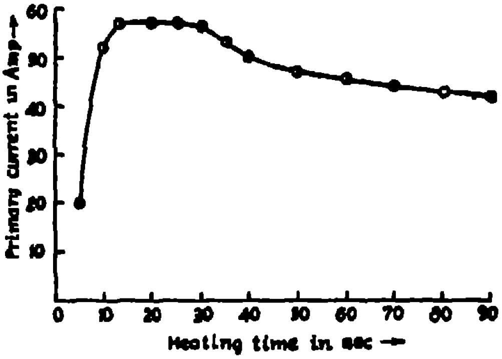

FIG 2 — BEHAVIOUR OF CURRENT WITH HEATING TIME

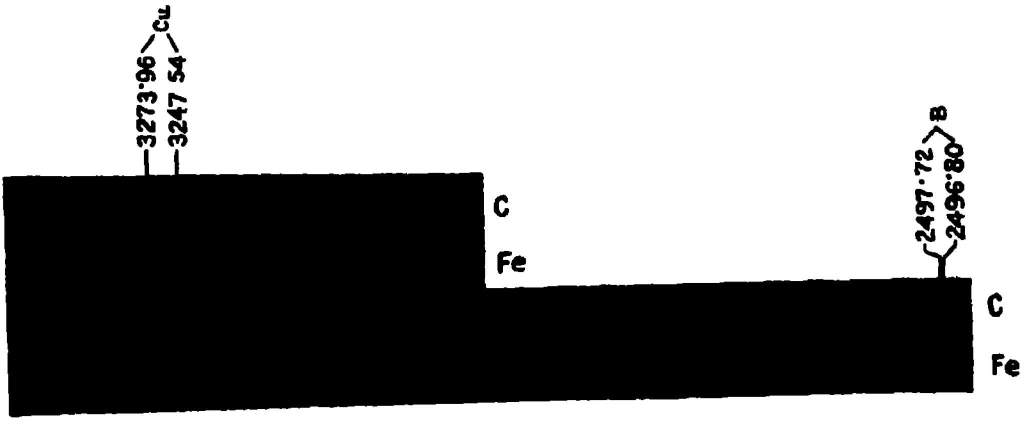

FIG 3 — CATHODE LAYER SPECTRUM OF " KINO-HOMOGEN " CARBON ROD (IMPURE)

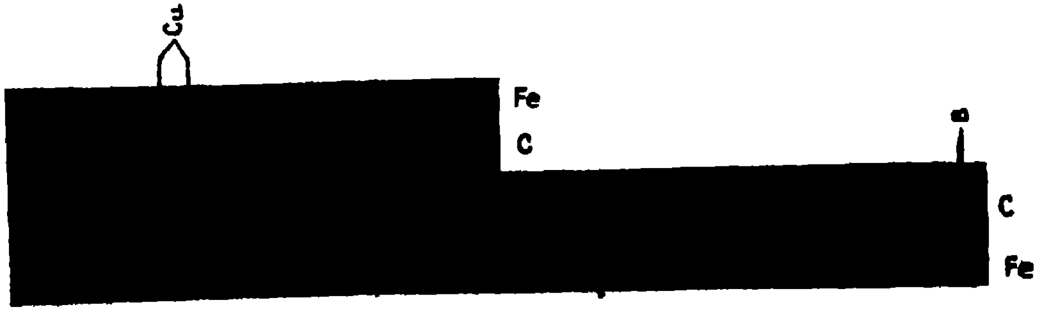

FIG 4 — CATHODE LAYER SPECTRUM OF CARBON ROD PURIFIED BY RESISTANCE HEATING

TABLE I — RESULTS OF SPECTRUM ANALYSIS OF THE PURIFIED CARBON ROD

Heated for 90 sec with i_{max} = 570A in an atmosphere of N_2-Cl_2 mixture (arc current 11 amp)

ELEMENT	SENSITIVE LINE λ IN I A	INTENSITY	HOOGLAND'S RESULTS (Arc current 5 5 amp)
B	2497 72 2496 80	+	+
Si	2516 12 2881 59	→o←	?
Mg	2795 54 2802 71 2852 12	→o←	+
T	3088 03 3371 45 3354 63	→o←	?
Al	3082 16 3092 71	→o←	?
Ca	3158 88 3179 34	→o←	(+)
Cu	3247 54 3273 96	→o	?
Fe	3020 64 3021 07	→o←	+

Symbols in column 3 + = considerable amount →o← = none to faint traces →o = faint traces.
Symbols in column 4 + = present ? = presence uncertain (+) = barely observable

Discussion

Carbon rod purified by the method of chemical treatment combined with heat treatment by resistance heating in an atmosphere of N_2 Cl_2 mixture is quite satisfactory for spectrum analysis by cathode layer arc (TABLE I) Traces of iron and magnesium present in Hoogland's purified carbon rod (by resistance heating in air) are almost completely removed by this method This is due to the fact that the presence of N_2 and Cl_2 gives more volatile compounds than oxides Considerable traces of copper were present in the purified carbon rod obtained by resistance heating in air[2] In the present case copper has also been practically removed Boron lines (2497 72Å 2496 80Å) are slightly reduced in intensity Boron cannot however be removed completely by the present method because this element usually forms non volatile compounds

Thanks are due to Prof P B Sarkar and Dr J W Whitaker for their keen interest in the work to Mr B M Banerjee for providing all facilities and help to work with the transformer and to the Director C S I R for the grant in aid

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Preparation of Phosphanilic Acid & Related Substances

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Methods for the preparation of phosphanilic acid and related substances have been investigated The ammonium salt of ω-chloro benzyl phosphinic acid shows feeble activity against *B coli* and *S aureus* *p p*′-Diaminodibenzyl phosphinic acid is inactive

BHIDE and Kanitkar[1] showed that phosphanilic acid is a powerful bacteriostatic agent for both gram positive and gram negative bacteria For a pharmacological investigation a large quantity of phosphanilic acid was required and methods for the preparation of this compound and related substances were therefore investigated

Phosphanilic acid is prepared from *p* chlorophenyl phosphinic acid by treatment with ammonia in the presence of cuprous oxide under pressure[2] *p* Chlorophenyl phosphinic acid is also prepared by the action of phosphorus trichloride on chlorobenzene in the presence of aluminium chloride Kosolapoff[3] has shown that better yields of the acid could be obtained by chlorinating the reaction mixture in acetylene tetrachloride followed by the addition of absolute alcohol when diethyl ester of *p* chlorophenyl phosphinic acid is formed

With a view to establishing conditions for obtaining the maximum yield of diethyl *p* chlorophenyl phosphinate three series of experiments viz (i) changing the duration of heating from 2 to 48 hr (ii) changing the quantity of PCl_3 from 0 5 to 2 mol and (iii) changing the quantity of aluminium chloride from 0 25 to 1 mol have been conducted

The optimum conditions for preparing the diethyl *p* chlorophenyl phosphinate have been found to be as follows

Phosphorus trichloride — 1 mol *p* chloro benzene — 1 mol aluminium chloride — 0 5 mol heating period — 6 hr

The percentage yield on chlorobenzene is 29 6 per cent of the theoretical

The optimum conditions for the hydrolysis of the diethyl ester of *p* chlorophenyl phosphinic acid were by heating the ester with 8 times its weight of concentrated hydrochloric acid for 5 hr on a sand bath The yield is nearly quantitative

A number of experiments were also carried out to determine the best conditions for the transformation of *p* chlorophenyl phosphinic acid into phosphanilic acid but the original procedure used by Bauer (loc cit) was found to be the best The results of pharmacological investigations will be reported in a separate communication

It seemed of interest to prepare ω amino benzyl phosphinic acid NH_2 CH_2 C_6H_4 PO_3H_2 analogous to the corresponding sulphanilamide derivative marfanil

Attempts were made to prepare *p* cyano phenyl phosphinic acid which on reduction might yield the marfanil analogue But the preparation of *p* cyano phenyl phosphinic acid by the diazo reaction from phosphanilic acid or treatment of *p* chlorophenyl phosphinic acid with potassium cyanide under a variety of conditions failed to give the product Ultimately the following procedure was adopted

p Toluyl phosphinic acid was chlorinated in acetic acid to yield *p* ω-chloro benzyl phosphinic acid m p 162°C This on treatment with ammonia gave the ammonium salt of the desired acid The acid ammonium salt could be isolated by acidification with hydrochloric acid Bacteriological tests with *B coli* and *S aureus* showed only feeble activity for this compound

p p dinitro dibenzyl phosphinic acid[4] on reduction with ferrous sulphate and ammonia gave *p p* diamino dibenzyl phosphinic acid m p 303°C This compound however did not possess any anti bacterial activity

The sodium salt of *p* nitrophenol and *p* chlorophenyl phosphinic acid gave *p* nitro phenoxy phosphinic acid m p 288°C All attempts to reduce this acid have so far failed

Experimental

Chlorination of p Toluyl Phosphinic Acid — *p* Toluyl phosphinic acid (4 gm) was dissolved in acetic acid (30 c c of 100 per cent acid) and dry chlorine was passed in sun light till there was no further increase in weight The liquid was evaporated to dryness on a steam bath Distilled water was added to it and again evaporated to dryness The product was dissolved in dry acetone and precipitated by adding dry chloroform yield 1 g m p 161°C

The compound is insoluble in benzene ether petroleum ether carbon tetrachloride and chloroform It is soluble in acetone methyl alcohol and ethyl acetate eq wt found 102 4 $C_7H_8O_3PCl$ requires 103 2 Cl found 17 42 $C_7H_8O_3PCl$ requires Cl 17 19 per cent

Preparation of the Acid Ammonium Salt of ω amino Benzyl Phosphinic Acid — 50 c c ammonia were added to the product (1 gm) obtained by chlorinating *p* toluyl phosphinic acid and heated on a steam bath for 5 hr and then evaporated to dryness The residue was redissolved in water and precipitated by adding hydrochloric acid till acid to Congo red and crystallized from water This product was insoluble in dioxon chloroform ether petroleum ether benzene and carbon tetrachloride It is sparingly soluble in acetone and methyl alcohol Yield 0 2 gm It did not melt up to 350°C Found P 15 44 $C_7H_{13}O_3N_2P$ requires P 15 2 per cent

Reduction of p p-dinitro-dibenzyl Phosphinic Acid — The acid (5 gm) was treated with a solution of 50 gm of ferrous sulphate and dilute ammonia The ferric hydroxide was filtered off and the filtrate concentrated On acidifying to Congo red *p-p* diamino-dibenzyl phosphinic acid was precipitated and crystallized from water as clusters of needles, m.p. 303°C. Found N, 9·5, $C_{12}H_{11}O_{4}N_{2}P$ requires N, 10·1 per cent

The diacetate was prepared by treating a solution of the acid in pyridine with acetic anhydride Found N, 7 9, $C_{16}H_{15}O_{6}N_{2}P$ requires N, 7 8 per cent.

Preparation of p-nitro-phenoxy Phosphinic Acid — 4·33 gm *p*-nitrophenol and 3 33 gm sodium hydroxide were heated at 130°C. The mass was powdered and mixed with 5 gm of *p*-chlorophenyl phosphinic acid and 0·5 gm. copper bronze. Dry xylene was added and the whole mass was refluxed for 10 hr. Xylene was removed and the product added to water and made slightly alkaline with sodium hydroxide and filtered The filtrate was made acidic to Congo red and washed with ether to remove unreacted *p*-chlorophenyl phosphinic acid. The pure compound melted at 288°C, yield 3 5 gm Found N, 4·97, $C_{12}H_{10}O_{6}NP$ requires N, 4 74 per cent, eq wt found 148 9, $C_{12}H_{10}O_{6}NP$, eq wt, 147 5

Preparation of p-cyanophenyl Phosphinic Acid — To a mixture of 8·8 gm of potassium cyanide and 4 74 gm nickel chloride in 50 c c. water was added diazotized phosphanilic acid (3 5 gm) and heated on a water bath for 5 hr It was made acidic to Congo red with hydrochloric acid and filtered The precipitate was washed with water, washings added to the filtrate and made alkaline with ammonia The magnesium salt was precipitated by boiling with magnesia mixture This was dissolved in acetic acid and the lead salt was precipitated by lead acetate This was decomposed by adding a calculated amount of sulphuric acid and filtered The filtrate was evaporated to dryness and the product crystallized from water, yield 0·5 gm, m.p *c* 143°C. The compound also gave a feeble test for chlorine. It could not be further purified Nitrogen, found 13·28, *p*-cyano-phenyl phosphinic acid requires N, 7·649 per cent

Attempts were also made to prepare *p*-cyano-phenyl phosphinic acid by heating *p*-chlorophenyl phosphinic acid, potassium cyanide and copper cyanide under pressure. Copper cyanide (5 gm), potassium cyanide (5 gm) and *p*-chlorophenyl phosphinic acid (5 gm) dissolved in methyl alcohol were heated at 150°C for 6 hr. under pressure. Alcohol was removed and the mass dissolved in sodium bicarbonate and filtered. The filtrate was made acidic to Congo red with nitric acid and filtered The lead salt was precipitated by adding lead acetate to the filtrate It was decomposed by the addition of theoretical quantity of sulphuric acid and filtered The filtrate was evaporated to dryness and the compound crystallized from water. This was identified as *p*-chlorophenyl phosphinic acid

Use of other solvents in the presence of copper cyanide did not also give the product.

The cost of this investigation was borne by the Council of Scientific & Industrial Research to whom our thanks are due.

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Extraction of Germanium from Sphalerite Collected from Nepal—Part II

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A method for the extraction of germanium from the non-magnetic fraction of the mineral sphalerite has been described

IN the previous communication[1] we have described the extraction of germanium dioxide from the magnetic fraction (mainly magnetite) of sphalerite The non-magnetic portion left over was found to contain traces (0 006-0 04 per cent) of germanium

The spectrogram of this portion revealed the presence of the following elements lead, zinc, iron, silicon, germanium tin, copper, cadmium, silver and antimony, of which the first two predominate The ore was analysed as before and the germanium estimated according to the method already described

The analytical results are as follows

	%
Pb	14 2
Zn	48 4
S	27 3
SiO_2	5 6
Fe	2 3
Ge	0 0021

From the analytical data this fraction of the mineral appears to be mainly a sulphate of zinc and lead

Extraction of Germanium

A procedure different from the one adopted for magnetite had to be adopted for the extraction of germanium from this fraction When the ore is treated with sulphuric acid the insoluble lead sulphate formed retains the major portion of the germanium but if the sulphuric acid is completely fumed off, most of the germanium goes into solution and only traces remain over with the precipitates of lead sulphate and sulphur

The methods of Winkler, Buchanan[2], etc, were found to be unsuitable for the extraction of germanium Tchakirian's method[3] was finally adopted The insoluble residue was refluxed with a saturated solution of ammonium bioxalate and, curiously enough, not even a trace of germanium was found in the solution A new method based on the fact that the insoluble residue containing free sulphur is totally converted to lead sulphide on treatment with concentrated sodium hydroxide solution was adopted The dismutation of free sulphur in strongly alkaline medium takes place as follows

$$4S + 6O\bar{H} = 2\bar{S}^{-} + \bar{S}_2\bar{O}_3 + 3H_2O$$

The lead sulphide so formed carried with it the whole of germanium as disulphide and the lead sulphide is separated by treatment with 2N hydrochloric acid

Experimental

400 gm of the ore were decomposed by an excess of 1 1 sulphuric acid, the resulting mixture heated to dryness and the excess acid fumed off A large part of the free sulphur was removed by this treatment The dried mass was extracted with hot water and filtered Sodium sulphide, just sufficient to precipitate one-tenth of the total zinc, was added[4] The filtrate was rejected as spectroscopic examination showed the absence of germanium The residue was treated with 4N sulphuric acid and digested on a water bath for an hour and filtered Germanium disulphide was left in the residue and most of the elements including zinc were thus removed The residue was treated with sulphuric and nitric acids and dried. It was then distilled with 50 c c of 1 1 hydrochloric acid and the distillate treated according to the procedure already described. Germanium dioxide thus obtained was found from spectroscopic evidence to contain traces of antimony and tin

When the residue was treated with concentrated sodium hydroxide solution, the whole of germanium was precipitated along with lead sulphide This precipitate was digested with 2N hydrochloric acid, filtered and washed Almost the whole of lead goes into solution leaving behind germanium disulphide silicon dioxide titanium silver and traces of lead Silicon dioxide was the principal constituent All the vapours issuing during the treatment were collected and found to be spectroscopically free from germanium showing that germanium disulphide is not decomposed by 2N hydrochloric acid The residue was then treated with sulphuric and hydrofluoric acids and evaporated on a water bath when all the silica was removed The mass was then distilled with hydrochloric acid as previously described and the germanium dioxide separated The resulting product contained traces of phosphorus derived from hydrogen peroxide The yield was 240 mg of germanium dioxide from 4 kg of the non magnetic fraction

Our best thanks are due to Prof P B Sarkar for his keen interest in the investigation and to the *Council of Scientific & Industrial Research* for financial help to one of us (R K Dutta)

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Studies in Industrial Micro-organisms Part IV — Vitamin Requirements of 27 Strains of Lactic Acid Bacteria

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The vitamin requirements of 27 strains of lactic acid bacteria have been determined *L C* 20 NCTC 2171 *L arabinosus* NCTC 2161 and *S faecalis* NCTC 2175 have been shown to be suitable for the assay of all B vitamins excepting thiamin and pyridoxin

A STUDY of the vitamin requirements of 27 strains of lactic acid bacteria maintained in the National Collection of Type Cultures India Indian Institute of Science Bangalore has been carried out with the object of determining their suitability as test organisms for the microbiological assay of vitamins and other growth factors

Experimental

Method of Carrying Cultures — The stab cultures were carried in an enrichment medium described by Mistry and Sreenivasaya[1] 100 c c of the enrichment medium contained 0 5 gm of sheep liver extract 0 5 gm of *Difco* yeast extract 0 5 gm of *Difco* peptone 0 5 gm each of glucose and lactose 1 0 gm of sodium acetate 0 5 c c each of salts A and B and 2 0 gm of agar The cultures were grown in the enriched broth for 24 hr at 37°C transferred to the stabs incubated till there was visible growth (24 to 36 hr) and then preserved at 5°C The stabs were subcultured every month

The full complement medium in double strength (similar to the one used by Landy and Dicken[2]) was compounded to include all the vitamins and amino acids (as casein hydrolysate supplemented with tryptophane and cystine) The composition of the medium is given in Table I

Media deficient in a particular vitamin were prepared by omitting the particular vitamin 5 0 c c of the medium were transferred into tubes and plugged with cotton In the case of folic acid assays glass caps instead of cotton plugs were used since cotton was reported to contain appreciable amounts of pteroyl glutamic acid Duplicates were run in each case The tubes were sterilized at 15 lb pressure for 15 min incubated for 24 hr at 37°C and steamed for 30 min

Inoculum was prepared by transferring a small amount of growth from the stab culture to 5 c c of the enriched medium broth incubated for 24 hr at 37°C, aseptically washed three times on the centrifuge with sterile saline (0 89 per cent) and the sedimented bacteria taken up with 25 c c of sterile saline

One drop of the above suspension was added to each of the tubes and incubated at 37°C for 72 hr The acid produced during this period was titrated against 0 1N NaOH using bromothymol blue as indicator

The results are given in Table II

A study of the results (TABLE II) shows

(i) most of the organisms 24 out of 27 need pantothen

(ii) riboflavin is required by 10 strains

(iii) 15 strains need an external supply of niacin

TABLE I — COMPOSITION OF THE MEDIUM

Glucose (anhyd)	4 0 gm
Na. acetate (anhyd)	2 4 gm
Casein hydrolysate (acid)	0 5 gm
l-cystine	10 0 mg
l trytophane	10 0 mg
Adenine guanine Uracil xanthine	1 0 mg each
Salts A and B	0 5 c c each
Thiamine	20 0 μg
Riboflavin	20 0 μg
Pyridoxine	100 0 μg
Ca pantothenate	20 0 μg
Nicotinic acid	50 0 μg
Paba	20 0 μg
Biotin	100 0 mμg
Folic acid	500 0 mμg
pH	6 8 *to* 7 0
Volume	100 c c

TABLE II — VITAMIN REQUIREMENTS OF LACTIC ACID BACTERIA

(Results expressed as c c of 0 1N acid produced per 10 c c of the medium)

MEDIUM	1 *L arabinosus* 2160*	2 *L arabinosus* 2161	3 *L arabinosus* 2162	4 *L arabinosus* 2163	5 *L delbruckii* 2168	6 *L delbruckii* 2160	7 *L casei* 2156	8 *L casei* 2157	9 *L casei* 2159
Full med (all vits) (1)	16 4	17 3	16 7	14 35	11 5	14 8	11 95	13 9	11 0
(1) B_1	15 8	15 45	15 8	13 9	10 5	14 8	11 95	14 35	10 5
(1) B_2	16 4	17 3	15 8	13 9	10 5	11 95	3 85	2 4	4 8
(1) B_6	16 4	17 2	16 7	13 9	11 45	11 0	10 0	8 9	10 0
(1) Pantothen	2 4	8 7	3 2	2 4	11 0	2 85	3 8	3 1	4 8
(1) Niacin	8 6	3 05	8 95	7 2	11 0	10 1	11 95	12 5	10 2
(1) Biotin	13 9	6 7	14 3	13 5	11 1	14 3	12 5	12 80	11 45
(1) Folic	14 4	17 0	15 55	14 8	11 45	14 35	13 4	13 9	11 95
Enriched medium	8 8	10 5	9 0	7 7	9 6	5 6		10 5	

* Refer to NCTC numbers

TABLE II — *continued*

MEDIUM	10 *L casei* NCTC 2179	11 *L casei* NCTC 2154	12 *L casei* NCTC 2155	13 *L helveticus* NCTC 2167	14 *L C* 15 NCTC 2172	15 *L C* 20 NCTC 2171	16 *L C* 134 NCTC 2182	17 *L pentoaceticus* NCTC 2181	18 *S* 30 NCTC 2183
Full med (all vits) (1)	14 35	14 35	14 35	11 6	10 5	19 9	9 95	5 8	11 9
(1) B_1	13 85	15 30	13 9	12 2	10 8	22 0	5 3	4 4	12 0
(1) B_2	2 40	14 85	2 4	3 25	4 75	1 8	0 9	4 8	4 35
(1) B_6	8 9	14 35	11 45	12 8	10 2	16 0	9 0	2 4	12 0
(1) Pantothen	3 1	2 4	3 1	5 1	3 9	2 7	2 85	3 2	4 9
(1) Niacin	12 5	11 95	12 8	9 05	4 9	2 65	2 65	2 9	4 6
(1) Biotin	13 35	13 4	12 65	9 35	8 6	8 0	6 7	4 8	8 75
(1) Folic	14 35	14 85	13 9	11 40	7 7	18 6	8 15	4 8	11 3
Enriched medium	9 0	10 0	11 0			9 5		4 0	

TABLE II — *continued*

MEDIUM	19 *S* 200 NCTC 2170	20 *S* 228 NCTC 2184	21 *S* 253 NCTC 2178	22 *S faecalis* NCTC 2166	23 *S faecalis* NCTC 2174	24 *S faecalis* NCTC 2175	25 *S faecalis* NCTC 2176	26 *Leuc mesenteroides* NCTC 2169	27 *Leuc mesenteroides* NCTC 2177
Full med (all vits) (1)	11 8	12 85	5 8	9 55	12 4	14 10	11 5	13 05	22 6
(1) B_1	11 3	8 8	6 0	9 5	10 5	13 6	11 5	13 0	24 0
(1) B_2	5 15	8 25	5 15	9 6	12 0	14 0	7 65	13 45	23 8
(1) B_6	12 35	11 65	4 1	6 0	3 75	5 5	2 85	13 0	22 7
(1) Pantothen	4 1	4 10	4 75	3 8	2 5	2 4	7 0	2 75	6 2
(1) Niacin	4 25	4 75	3 1	7 8	3 75	2 0	4 0	1 85	2 2
(1) Biotin	8 6	9 25	6 2	8 1	5 4	2 4	4 4	4 04	8 3
(1) Folic	11 55	10 5	5 8	9 1	5 6	2 0	4 6	12 4	23 8
Enriched medium					5 0	7 0			

(iv) biotin has been found to be essential for 8 strains and
(v) 3 strains respond to folic acid and pyridoxine

Most of the strains of *L casei* and related species respond to riboflavin Folic acid is required by all the three strains of *S faecalis*[2,3] except that 4 per cent glucose and 2 4 per cent sodium acetate have been used instead of the usual 2 0 and 1 2 per cent respectively It was thought that the concentration of the vitamins and amino acids used in the 4 per cent sugar medium may be sub optimal for growth and acid production A decrease in the sugar percentage or an increase in the concentration of vitamins and amino acids should enhance the percentage of acid produced For this purpose an experiment was conducted with the three cultures *L arabinosus* NCTC 2161 *L C* 20 NCTC 2171 and *S faecalis* NCTC 2175 which are very useful for the assay of many of the B vitamins The composition of four media used in this experiment is given in Table III

The all-vitamin medium D corresponds to that of Roberts and Snell[4] Media lacking a given vitamin at a time were simultaneously run along with this series The rest of the experimental procedure was the same as that described earlier The results are given in Table IV

The results reveal that with higher dosages of the vitamins the sugar content of the media remaining the same there is a higher percentage of the conversion of sugar into acid The acid production is increased with a threefold enhancement in the concentration of vitamins When the concentration of the sugar is doubled in the media the level of vitamin concentration remaining the same there is not a corresponding increase in the percentage of acid production (TABLE IV) In the case of *L C* 20 and *S faecalis* the increase is nearly 50 0 per cent whereas in the case of *L arabinosus* whose optimal requirements for vitamins are not so

TABLE III — COMPOSITION OF THE MEDIUM

(*pH* 6 8 *to* 7 0)

	CONSTITUENTS PER 100 C C OF THE MEDIA	A	B	C	D
1	Glucose gm	4 0	2 0	2 0	2 0
2	Na acetate gm	2 4	1 2	1 2	1 2
3	Casein hydrolysate *l*-cystine *l* tryptophane salts A and B adenine guanine uracil xanthine same as before				
4	Thiamin μgm	20 0	20 0	60 0	50 0
5	Riboflavin μgm	20 0	20 0	60 0	50 0
6	B_6 μgm	100 0	100 0	300 0	100 0
7	Pantothenate μgm	20 0	20 0	60 0	50 0
8	Niacin μgm	50 0	50 0	150 0	100 0
9	Biotin μgm	100 0	100 0	300 0	200 0
10	Folic acid μgm.	0 5	0 5	1 5	1 0

TABLE V — LACTIC BACTERIA USEFUL FOR THE ASSAY OF B VITAMINS & THEIR ASSAY RANGES

VITAMIN	CULTURES: Foreign	CULTURES: NCTC (India)	ASSAY RANGES MR PER 10 C C: Foreign	ASSAY RANGES MR PER 10 C C: NCTC (India)
Riboflavin	*L casei* 7460	*L C* 20[5]	0 200[5]	
				0 150[6]
	Leuc Mesent[5]			
		L casei 2157[6]		
		L casei 2179	0 10	
Ca pantothenate	*L casei* ATCC 7469	*L arabinosus* 2161		0–150
		L c 20 2171[5]	0–120	0–300
		L casei 2157		
	L arabinosus[6] ATCC 8014		0–200	
Niacin		*L arabinosus* 2161		0–400
	L arabinosus 125		0–500	0–400
		L C 20, 2171		
Biotin	*L casei*[6] 7460	*L arabinosus* 2161	0 10	
		L c 20 2171		0 0 75
	L arabinosus	*L casei* 2157[6]	0–4 0	0–0 70
Folic acid	*S faecalis* R[6]		0 1 0	
	A C T C. 8043	*S faecalis* 2175		

TABLE IV — EFFECT OF THE CONCENTRATION OF VITAMIN & CARBOHYDRATES ON ACID PRODUCTION

(*c c of* 0 1 *N acid produced per* 10 *c c of the medium*)

VITAMIN MIXTURE	*L.C* 20 NCTC 2171				*L arabinosus* NCTC 2161				*S faecalis* NCTC 2175			
	A	B	C	D	A	B	C	D	A	B	C	D
All vits	19 9	11 9	18 0	17 0	17 8	16 0	19 0	19 0	14 0	6 5	10 2	9 6
Lacking B	22 0	12 0	18 5	17 5	15 45	15 0	18 0	19 5	13 6	6 8	9 5	9 0
B_2	1 8	0 5	0 8	1 0	17 3	15 8	16 5	18 0	14 0	6 5	5 7	8 5
B_6	16 0	10 0	11 6	12 0	17 2	15 0	17 0	17 0	5 5	6 0	6 3	5 5
Pantothen	2 7	1 3	1 6	1 8	3 7	0 8	1 6	2 0	2 4	1 0	1 6	1 8
Niacin	2 65	1 2	1 6	2 2	3 05	1 6	1 5	1 6	2 0	1 0	1 4	1 6
Biotin	5 2	6 2	7 6	8 0	6 7	5 0	5 0	8 0	2 4	2 0	2 0	2 0
Folic acid									2 0	1 6	1 0	2 5

high as those of the other two the increase is only 16 to 20 per cent

The results obtained with media lacking one of the vitamins at a time confirm the earlier findings and show that increased dosages of other vitamins do not potentiate any rise in acid production unless the vitamin *essential and indispensable* to the organism is present in other words the stability of the organism with respect to its vitamin requirements is not altered in spite of a 300 per cent increase in vitamin concentration

The following cultures have been found to be useful in the assay of the B-complex vitamins The assay ranges of our cultures have been compared with those cited in literature

The two cultures *L C* 20 and *L arabinosus* have been extensively used in our laboratory for the assay of B vitamins in some of the natural extracts

Summary

1 The vitamin requirements of 27 strains of lactic acid bacteria have been determined following the method of Snell and the procedure has been described

2 Pantothen and niacin are required by 24 and 15 strains respectively Ten strains require riboflavin and biotin is needed by 8

3 The suitability of some of these strains for the assay of vitamins has been indicated

4 The effect of the concentrations of vitamins and of carbohydrates on acid production by the organisms has been elucidated

5 *L C* 20 NCTC 2171 *L arabinosus* NCTC 2161 and *S faecalis* NCTC 2175 can be used for the assay of all B vitamins with the exception of thiamin and pyridoxine

This work forms a part of the scheme on the National Collection of Type Cultures India sponsored by the Council of Scientific & Industrial Research India whose generous financial help is gratefully acknowledged Grateful thanks are due to the Director Indian Institute of Science for his kind interest

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Substitution of Coconut Oil in Soap

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Coconut oil can be substituted with advantage in soap manufacture by mixtures of lauric acid rich fats such as Pisa fat (from *Actinodaphne hookeri*) castor oil groundnut oil and hydrogenated rosin.

COCONUT oil is an essential ingredient for the manufacture of high grade soaps and it usually forms 25 30 per cent of the total fat used The soap is easily soluble in water giving profuse lather and possessing excellent wetting and detergent properties As there is a shortage of edible fats in this country at present there is an imperative need for substituting coconut oil by other fatty materials in the soap and hair oil industries

The excellent properties of coconut oil soap are mainly due to the presence of lauric and myristic acids as major components of the total fatty acids of coconut oil[1] The effect of alkyl chain length on the properties of soap such as Herbig number, time of sinking and drop number has been investigated by Shirolkar and Venkataraman[2] Of the various saturated fatty acid soaps, sodium and potassium myristates have been found to possess the maximum wetting action, foaming and detergent properties at ordinary temperatures As inedible oils with myristic acid as a major component are not available in sufficient amounts in India, attention has been diverted to the investigation of lauric acid-rich oils Seeds of *Actinodaphne hookeri*, *Actinodaphne angustifolia*, *Cinnamomum camphora*, *Laurus nobilis*, *Litsea chinensis*, *Litsea sebafera*, *Litsea citrata* and *Litsea zeylanica* are available in Indian forests and their fats have been found by Puntambekar[3], Puntambekar and Krishna[4] and Collins[5] to contain 43 to 96 per cent lauric acid In the present investigation the seed fat of *Actinodaphne hookeri*, locally known as Pisa fat, is used in place of coconut oil in soap Its fatty acids consist of 96 per cent lauric acid. Castor oil and groundnut oil mixtures along with Pisa fat have also been tried

Hydrogenated rosin is a valuable ingredient of soap preparations[6] Its sodium derivative has been recommended as a substitute for coconut oil in soap[7] The sodium salt of rosin was used in admixture with other sodium soaps to ascertain whether it can replace coconut oil in soap manufacture Lather value, hardness, wetting and detergent tests were carried out on each sample of soap Soaps thus prepared were found to be comparable to the usual tallow-coconut oil soaps in many applications.

Experimental

In order to obtain alkali-free neutral soaps the oils and fats used in this investigation were first hydrolysed to fatty acids and neutralized by the addition of requisite amounts of a strong solution of caustic soda. The reaction was completed by heating on a water bath for 1 hr. The sodium soap so formed was dried in the sun to a moisture content of about 10 per cent Hydrogenated rosin was similarly treated The soap was then milled in a three-roll mill and the moisture content was finally adjusted to 10-12 per cent as determined by the Xylol method[8]. 40 gm. of this material was moulded to a cylindrical cake of 1½" dia. by pressing for 5 min. under a pressure of about 250 lb / sq in at a temperature of 40°C. ± 5°C The cakes were aged for a week in closed glass vessels The following determinations were made

1 *Lather Value*—The lather value was determined by shaking 50 c c of 0 2 per cent soap solution in one litre stoppered graduated cylinder for 30 sec. and noting the volume of the lather produced after 5 min The stability of the lather was found out by noting the volume again after 24 hr. The values were determined at room temperature (25°-30°C.)

2 *Wetting Test*—The concentration of soap required for causing the sinking of a 5 gm of skein of grey cotton yarn in 25 sec at 40°C was determined by Drave's method

3 *Hardness*—The comparative hardness of different samples of soap was determined by determining the weight (in lb) required to pierce through and break the cake A bronze hemisphere, 2 cm. dia, was employed for this purpose A cement testing machine was suitably modified for carrying out this test

4 *Detergency Test*—A piece of long cloth was first boiled in sodium carbonate solution, thoroughly washed with water and dried It was soiled in petrol ether to which carbon black (1 per cent), groundnut oil (2 per cent) and mineral lubricating oil (2 per cent) were added The cloth was dried in the sun by spreading horizontally on a frame Test pieces, 5"×5", having an even shade were chosen. The test piece was shaken in 100 c c of 0 3 per cent soap solution for half an hour with distilled water The test piece was then dried in shade and the extent of soil removed was examined visually The above test was done in duplicate with each sample of the soap

The composition of various soap samples together with their lather value, wetting test value and hardness are given in Table I. The detergent qualities of all the samples were found to be almost identical.

Discussion

From the data given in Table I it is seen that substitution of lauric acid-rich Pisa fat for coconut oil has increased the lather value in samples 2, 4 and 5 Less lather has been obtained in sample 3 due to the partial substitution of a longer chain stearic acid in place of Pisa fat[2]. Again,

TABLE I — COMPOSITION & PROPERTIES OF VARIOUS SAMPLES OF SOAP

No.	Acid composition of soap	Lather value		Drave's wetting test values (soap concentration required for 25 sec. wetting time), gm./litre	Hardness, lb.
		5 min., c.c.	24 hr, c.c.		
1.	Tallow 75% + coconut oil 25%	230	195	0 56	52 0
2.	Tallow 75% + Pisa fat 25%	250	210	0 72	66 0
3.	Tallow 75% + Pisa fat 15% + stearic acid 10%	200	160	0 68	69 5
4.	Tallow 65% + Pisa fat 25% + castor oil 10%	300	265	0 55	58 6
5.	Tallow 65% + Pisa fat 25% + groundnut oil 10%	280	230	0 57	60 75
6.	Tallow 60% + castor oil 20% + groundnut oil 20%	280	240	0 49	48 8
7.	Tallow 75% + rosin 25%	210	170	0 56	85 0
8.	Tallow 75% + hyd rosin 25%	240	200	0 67	91 6
9	Tallow 65% + Pisa fat 25% + rosin 10%	240	200	0 52	64 0
10.	Tallow 65% + Pisa fat 25% + hyd. rosin 10%	280	240	0 56	76 0
11.	Tallow 60% + groundnut oil 15% + hyd. rosin 25%	270	200	0 56	66 5
12.	Hyd. groundnut oil (I V 20-22) 75% + Pisa fat 25%	290	Thinned	0 57	58 0

substitution of 10 per cent castor oil and groundnut oil in samples 4 and 5 for the same amount of tallow (sample 2) has resulted in a marked increase in the lather value Drave's wetting test values for these two soaps have also been quite low and are quite close to that of coconut oil soap They were also found to be less hard than others because castor and groundnut oils are known to give softer soaps than oils containing predominantly saturated acids The effect of the soap from these two oils is very clearly indicated by the results of the values of sample 6 containing tallow, 60 per cent, castor oil, 20 per cent and groundnut oil, 20 per cent This soap has given lather value higher and wetting test value lower than coconut oil soap (sample 1) although the hardness has been slightly lower than the latter.

Hydrogenated rosin soap has given a quite good lather value (samples 8 and 10) and has proved better in comparison with ordinary rosin soap (samples 7 and 9) It also retards spotting in soap on storage which usually takes place when ordinary rosin is used. But a combination of lauric acid soap along with that of hydrogenated rosin has definite advantages Substitution of Pisa fat (lauric acid) by groundnut oil and hydrogenated rosin (sample 11), however, lessens the stability of the lather of the soap

An attempt was also made to substitute tallow by hydrogenated groundnut oil (I V. 20-22) Although a good amount of lather was obtained, it was very thin and subsided within 24 hr This may be due to the conversion of oleic acid mostly to stearic acid and partly to iso-oleic acid during hydrogenation The soaps of these two acids have less solubility and wetting action at low temperatures (25°-30°C) Other soaps (Nos 2 to 10) have given lathers of nearly equal stability and are almost identical to coconut oil soap

The hardness of all the samples of soaps with the exception of No 6 have been found to be more than that of coconut oil soap (No 1) This may be due to the presence of 15-20 per cent capric and other lower acids present in coconut oil The existence of these acids in coconut oil is definitely a disadvantage because their sodium salts have very poor lather values and wetting action However, they are very soluble in water and are removed during the salting out stage But these acids have not been removed in the present work and were allowed to form a part of the soap The differences in hardness may not be regarded as a great drawback because by proper formulation of the oils and fats, it may be adjusted to the desired limit Samples 4, 5, 6 and 10 are quite satisfactory as substitutes for standard coconut oil soap

Conclusion

Coconut oil can be substituted in soaps by suitable mixtures of lauric acid-rich fats, castor oil, groundnut oil and hydrogenated rosin

As castor oil has important industrial uses and groundnut oil is an edible oil, work is being undertaken to employ other non-edible oils in soap manufacture

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supply of *Actinodaphne hookeri* seeds from which Pisa fat was obtained

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Studies in the Fermentation of Carbohydrates by Yeasts—Part III

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The fermentability of 22 carbohydrates by 30 strains of yeasts from the National Collection of Type Cultures has been investigated Glucose and fructose are easily fermented by all the yeasts examined Sucrose is not fermented by 2 strains 10 strains *do* not ferment galactose, and 8 among these do not ferment maltose also Raffinose is fermented partially by 18 strains and melizitose by 5 Rhamnose is fermented by only 1 strain None *of* the yeasts ferment lactose or starch Glycogen is partially fermented by 1 strain, inulin by 6 strains and dextrin by 4 strains 3 yeasts slightly ferment α-methyl-glucoside, and 9 β-methyl-glocoside

THE present paper is an extension of the earlier work[1,2] and describes the fermentability of 22 carbohydrates by 30 strains of yeasts from the National Collection of Type Cultures

In a recent review Bouthilet[4] points out that it is customary to use yeast extract in the basal media used for fermentation tests A number of yeasts were observed to ferment the yeast extract and trehalose From the taxonomic point of view the use of yeast extract in fermentation tests is open to objection as any positive fermentation observed may be ascribed to the sugars present even though they may not be fermentable Mrak and Phaff[5] have observed that 16 strains of yeasts studied by them ferment both yeast extract and trehalose Yeast extract contains appreciable quantities of trehalose

The use of dilute yeast autolysates as an additive to the basal medium overcomes the difficulty During autolysis of yeast trehalose is destroyed In order to evaluate critically the fermentation reaction of yeasts we have carried out the tests using yeast extract alone and yeast extract with added carbohydrates Of the 50 strains studied not one has given any positive fermentation with yeast extract alone

The procedure adopted by us in these studies has been described earlier[1,2] The results obtained are recorded in Tables I and II

Discussion

1 Among the yeasts studied N C T C 3084 ferments rhamnose Other pentoses are not fermented

2 Observations made after 24 hr intervals show that the rate of fermentation is the highest in glucose followed by fructose A time lag is observed in mannose fermentation

3 Of the 30 yeasts examined 10 did not ferment galactose Among the rest complete gas formation was not observed with 3 strains

4 Among the disaccharides, lactose is not fermented by any of the yeasts Sucrose

TABLE I

N C.T.C. No.	MONOSACCHARIDES							DISACCHARIDES		
	Abrabinose	Rhamnose	Xylose	Glucose	Fructose	Galactose	Mannose	Lactose	Sucrose	Maltose
3003	—	—	—	++++	++++	+++	++	—	++++	++++
3004	—	—	—	++++	++++	++++	++++	—	++++	++++
3019	—	—	—	++++	++++	+++	++++	—	++++	++++
3039	—	—	—	++++	++++	++++	++++	—	++++	++++
3040	—	—	—	++++	++++	++++	++++	—	++++	++++
3041	—	—	—	+++	++++	—	++++	—	—	—
3042	—	—	—	++++	++++	++++	++++	—	+++	++++
3043	—	—	—	++++	++++	++++	+++	—	++++	++++
3044	—	—	—	++++	++++	—	++++	—	++++	—
3045	—	—	—	++++	++++	—	++++	—	++++	—
3046	—	—	—	++++	++++	++++	++++	—	++++	++++
3049	—	—	—	++++	++++	++++	++++	—	++++	++++
3050	—	—	—	++++	++++	—	++++	—	++++	—
3051	—	—	—	++++	++++	—	++++	—	++++	—
3052	—	—	—	++++	++++	++++	++++	—	++++	++++
3053	—	—	—	++++	++++	++	++++	—	++++	++++
3054	—	—	—	++++	++++	++++	++++	—	++++	++++
3072	—	—	—	++++	+++	—	++	—	+++	—
3073	—	—	—	++++	++++	++++	++++	—	++++	++++
3074	—	—	—	++++	++++	++++	++++	—	++++	++++
3075	—	—	—	++++	++++	—	++++	—	++++	++
3076	—	—	—	++++	++++	++++	++++	—	++++	++++
3077	—	—	—	++++	++++	++++	++++	—	++++	—
3078	—	—	—	++++	++++	++++	++++	—	++++	—
3079	—	—	—	++++	++++	—	++++	—	—	—
3080	—	—	—	++++	++++	—	++++	—	++++	—
3081	—	—	—	++++	++++	++++	++++	—	++++	++++
3082	—	—	—	++++	++++	—	++++	—	+	+
3083	—	—	—	++++	++++	++++	++++	—	++++	++++
3084	—	+	—	++++	++++	++++	++++	—	++++	++++

—, no fermentation ; +, 0·5 cm. of gas formation , ++, 1·0 cm. of gas formation , +++, 1·5 cm. of gas formation , ++++, 2·0 cm. of gas formation.

TABLE II

N.C.T C. No.	POLYSACCHARIDES						ALCOHOLS		GLUCOSIDES			
	Raffinose	Melizitose	Starch	Inulin	Dextrin	Glycogen	Mannitol	Dulcitol	Salicin	Amygdalin	α methyl-glucoside	β-methyl glucoside
3003	+	—	—	+	—	—	—	—	—	—	—	—
3004	++	—	—	—	—	—	—	—	—	—	—	—
3019	+	—	—	+	—	—	—	—	—	—	+	—
3039	++	—	—	—	—	—	—	—	—	—	—	—
3040	+	—	—	++	—	—	—	—	—	—	—	—
3041	—	—	—	—	—	—	—	—	—	—	—	—
3042	+	—	—	—	—	—	—	—	—	—	—	—
3043	+	+++	—	+++	—	—	—	—	—	—	—	++
3044	+	—	—	—	—	—	—	—	—	—	—	—
3045	+	—	—	—	—	—	—	—	—	—	—	—
3046	+	—	—	—	—	—	—	—	—	—	—	—
3049	+	++	—	—	—	—	—	—	—	—	—	—
3050	++	—	—	++	—	—	—	—	++++	—	—	+++
3051	—	—	—	—	—	—	—	—	—	—	—	—
3052	+	—	—	+	—	—	—	—	—	—	—	—
3053	++	—	—	—	—	—	—	—	—	—	—	+
3054	—	—	—	—	—	—	—	—	—	—	—	—
3072	++	—	—	—	—	—	—	—	—	—	—	—
3073	++	—	—	—	—	—	—	—	—	—	—	—
3074	—	—	—	—	—	—	—	—	—	—	—	—
3075	++	—	—	—	+++	—	+	—	++++	—	—	+++
3076	+++	—	—	—	—	—	—	—	+++	—	—	—
3077	—	—	—	—	—	—	—	+	—	+	—	—
3078	—	—	—	—	—	—	+	—	+	—	—	+
3079	—	—	—	—	—	—	—	—	—	—	—	—
3080	—	—	—	—	—	—	—	—	—	—	—	+
3081	—	++++	—	—	++++	—	—	—	—	—	+	+
3082	—	—	—	—	—	++	—	—	—	—	—	—
3083	—	+++	—	—	++++	—	—	—	—	—	+	++
3084	—	+++	—	—	++++	—	—	—	—	—	—	++

—, no fermentation ; +, 0·5 cm. of gas formation , ++, 1·0 cm. of gas formation , +++, 1·5 cm. of gas formation , ++++, 2·0 cm. of gas formation.

is easily fermented and to the same degree as glucose except in the case of N.C.T C 3041 and 3079. Eight yeasts which did not ferment galactose also failed to ferment maltose.

5. Raffinose is partly fermented by 18 yeasts , the rest do not ferment it

6. Melizitose is fermented by the following 5 strains, some partially and others fully N.C.T C. 3043, 3049, 3081, 3083 and 3084.

7 Starch is not fermented by any of the yeasts Glycogen is partially fermented by N C T C 3082

8 Inulin is partially fermented by 6 yeasts N C T C 3003 3019 3040 3043 3050 and 3052

9 Dextrin is fermented by 4 strains N C T C 3075 3081 3083 and 3084 and mannitol amygdalin and dulcitol are fermented each by 1 strain of yeast

10 Three yeasts slightly ferment α methyl glucoside and nine ferment β methyl glucoside

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Letters to the Editor

A NEW POLARIZATION EFFECT REDOXOKINETIC POTENTIAL

When two platinum electrodes dipped in an aqueous solution containing a reversible redox system are connected to a source of alternating current it is found that a d c potential is developed at each of these electrodes This d c potential can be measured with reference to a third platinum electrode of a large area dipped in the same solution An electron tube voltmeter was improvised for measuring the same in order to avoid any large current being drawn by the measuring instrument The d c potential developed is found to be dependent on the magnitude of the a c current passing The general behaviour is reproducible though the actual values of the potential may not be precisely so under the present experimental conditions Two typical results obtained by using a saturated solution of quinhydrone in an acetate buffer of pH 4 8 are shown in Table I The sign of the potential as given in the table indicates the sign of the reference electrode

The important feature of this new phenomenon is that both the electrodes behave similarly. This shows at once that the phenomenon is not caused by any d c component in the a c current employed The phenomenon may be provisionally explained as folllows Normally when a platinum electrode is dipped in an aqueous solution containing quinhydrone its potential can be considered as being influenced by a number of redox systems such as (i) hydroquinone quinone (ii) hydrogen hydrogen ion (iii) hydroxylion oxygen etc But the potential is entirely controlled by the first named redox system Since there is sufficient time for interaction the activities of the components forming the other redox

TABLE I

Electrode X dia 0356 cm. length 6 cm
Electrode Y dia 0356 cm length 5 cm
Area of the reference electrode 2 5 sq cm

A C current milliamp	D C potential of Y in volts		D C potential of X in volts	
	after 2 min	after 15 min	after 2 min	after 15 m n.
Experiment 1				
0	0	0	0	0
512	− 039	− 039	− 044	− 042
768	− 044	− 043	− 047	− 047
1 54	− 046	− 045	− 050	− 048
2 56	− 032	− 028	− 038	− 028
3 074	− 012	− 011	− 023	− 020
Experiment 2				
0	0	0	0	0
512	− 037	− 036	− 038	− 037
768	− 041	− 040	− 042	− 041
1 54	− 043	− 042	− 045	− 044
2 56	− 028	− 022	− 036	− 030
3 074	0	+ 008	− 14	− 010

systems at the electrode will adjust themselves accordingly so as to conform to the same redox potential. But when an alternating potential is applied the relative velocities with which the various redox systems at the electrodes respond to the changing potential will differ. Further the concentration changes are also influenced by diffusion. The d.c. potential observed appears to be caused by these differential electrode kinetics of the redox systems. These phenomena may also be caused by the differential effect of the two half waves of the alternating current on the electrode reaction rates. The new effect has accordingly been referred to as 'redoxokinetic effect' and the potential produced as 'redoxokinetic potential'. It is to be noted that the present experiments were done with a well poised redox system. With a lightly poised system the effect would be much greater. The effect which appears to be general is being examined with other redox systems. The ferrous-ferric system has already given similar results.

This phenomenon gives a new method of approach for the study of electrode kinetics and is likely to throw light on the velocity of electrode reactions. The details of this work will shortly be published.

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Sugar Technology,
Kanpur,
September 28, 1950.

CAMPHOR PRODUCTION FROM *OCIMUM KILIMANDSCHARICUM* GUERKE

Ocimum kilimandscharicum GUERKE, a native of East Africa grows well in Bombay State especially in the southern tracts. It grows on all types of soils and in all climates and yields camphor in 6-7 months after sowing. It can be grown on waste lands, roadsides and along edges of fields and cattle do not browse on it.

The cultivation of this plant has been undertaken by the Forest Silviculturist in many parts of Bombay. With a view to finding the optimum conditions for the economic exploitation of this plant as a source of camphor investigations have been undertaken jointly by the Forest Silviculturist and the Forest Chemist, Government of Bombay.

A simple portable distillation plant has been designed and used in these studies. The still (40 gal. capacity) is fitted with a steam coil at the bottom and an exit at the top. The distillate is collected in an open vessel containing cold water which is kept immersed in a larger vessel containing water which is periodically changed. The camphor and oil which collect in the inner vessel are separated by filtration and the camphor present in solution in the oil is removed by refrigeration and filtration. The crude camphor thus obtained is purified by sublimation.

With a view to obtaining data on the effect of storage of leaves on the yield of camphor, fallen and withered leaves collected from the field, fresh leaves gathered from the plants and leaves collected from the plants and dried in the shade for a week were subjected to steam distillation. The withered leaves had been exposed to sun and rain for over 4 months. The yields of total distillate and camphor are given in Table I.

TABLE I

([illegible] figures in brackets give the range of values)

MATERIAL	AV. WT. OF CHARGE FOR DISTILLATION lb.	NO. OF DISTILLATIONS CARRIED OUT	TOTAL DISTILLATE %	CAMPHOR CONTENT %
Withered leaves*	1[illegible]	[illegible]	[illegible]4 ([illegible]14–[illegible])	1.[illegible]6 (1.[illegible]–1.[illegible]3)
Fresh leaves	[illegible]	[illegible]	[illegible]4 (0.26–[illegible])	0.19 (0.12–0.31)
Shade dried leaves†	18	13	[illegible]76 (0.53–1.06)	0.32 (0.2–0.4[illegible])

* Yield [illegible] on the weight of dried material.
† Calculated [illegible] the weight of fresh leaves. The yield of [illegible] per cent.

From the results given in Table I it will be seen that the yield of total distillate from leaves exposed for 4 months to adverse weather conditions is 2.64 per cent. This yield compares favourably with the 4 per cent yield obtained from shade dried leaves. Prolonged storage of leaves does not appear to adversely affect the yield of distillate.

It has been observed that the yield of distillate and the ratio of camphor to oil in leaf material vary according to the locality from which the material is gathered Further, the yields of camphor and oil from leaves collected from the same locality vary from season to season the yields are greater in the dry months and the ratio of oil to camphor in the total distillate is also higher

A comparison of yields from fresh and shade-dried leaves shows that it is advantageous to employ partially dried leaves for distillation Weight for weight a better yield of distillate is secured and there is considerable saving in fuel

Investigations are in hand to determine the optimum conditions for the cultivation and harvesting of *Ocimum kilimandscharicum*

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August 9 1950

OIL FROM THE SEED OF GOKHRU (*XANTHIUM STRUMARIUM*)

Gokhru (*Xanthium strumarium*) occurs abundantly throughout the hotter parts of India No large scale use for any product from this plant has been found although Watt[5] Chopra[1] and Nadkarni[4] have described a number of medicinal uses The seed is known to contain an oil briefly referred to by Lewkowitsch[3] as a lesser known semi drying oil A detailed study of the economic possibilities of the oil from this source has been undertaken in these laboratories

The seed is enclosed in a tenacious thorny cover which is difficult to remove by mechanical means It is not rendered brittle for easy crushing by heating dehydrating and even roasting It is not softened by soaking in water treatments with steam alkalies and common oxidizing agents are ineffective By soaking the thorny fruit in 2 5 per cent sulphuric acid for about 12 hr and then drying in the sun for a day or two the fruit coat softens and the seed can be obtained easily by lightly pressing between rollers and winnowing A number of batches can be treated from the same tank of acid solution until the acid strength is reduced to 1 5 per cent

The seed which is about a third of the weight of air-dry fruit contains 32 per cent oil The seed yield in the vicinity of Nagpur Agricultural College Farm was about 630 lb per acre during the year 1948-49 and 480 lb per acre during 1949 50 the plants being spaced 1 to 1 5 This represents an yield of about 175 lb of oil per acre Comparing this with yields of oils obtained from the usual cultivated oil seeds the oil yield from gokhru must be regarded as substantial enough to deserve attention

The physical and chemical constants of the oil are

	1948 49 *sample* (*ether extracted*)	1949 50 *sample* (*cold pressed*)
Ref index at 40 C	1 4697	1 4665
Sap val	202 5	192 0
Iod val	111 9	124 0
R M val	2 5	2 0

The oxygen absorption values of the oil according to the method described by Elsden[2] was 6 5 in 2 days 7 2 in 4 days 9 3 in 8 days and 11 7 in 12 days

A sample of oil stored for about a year out of contact with air was found to have developed a thick tenacious pale yellow transparent film slightly sticky but otherwise rubberlike The oil rapidly thickens on heating and the viscous product thus formed is miscible with mineral oils The hot oil at the point of jellification has good spreading properties and thin films dry rapidly Further work on the oil is in progress

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Agricultural Research Institute
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August 14 1950

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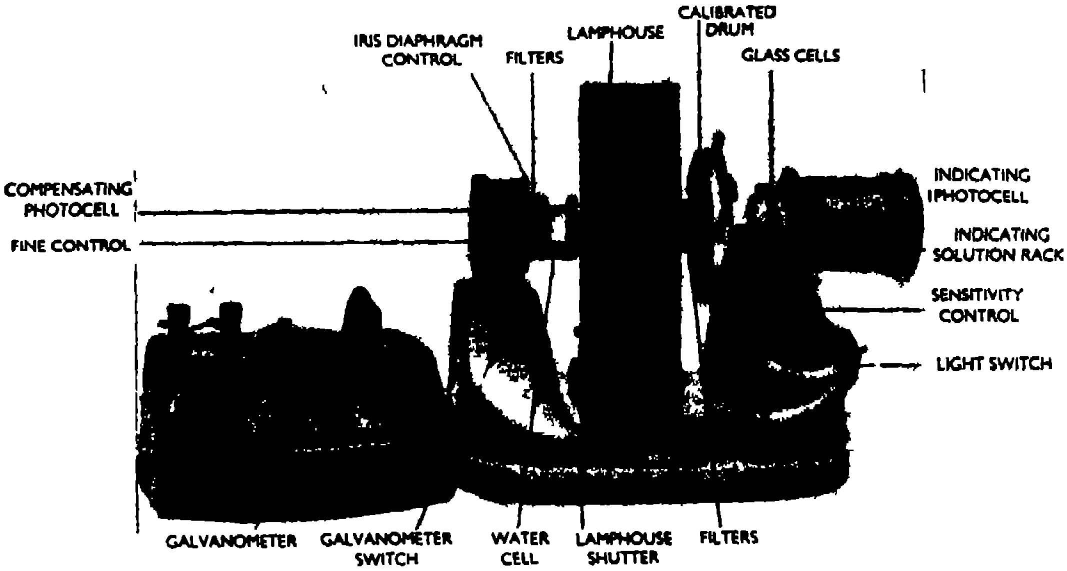

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Co-occurrence of the Positive & Negative Joshi Effect

D P JATAR

Chemical Laboratories Banaras Hindu University Banaras

Joshi effect in iodine vapour under sleeve excitation has been investigated Current oscillograms obtained in the dark and in light reveal the co occurrence of the positive and negative Joshi effect

DURING work on the potential variation of Joshi effect an almost instantaneous and reversible photo variation ($\pm\Delta i$) of the discharge current (i) some suggestive results were obtained when current measurements were made with systems charged with various vapours and gases in dark and in light using *simultaneously* more than one detector They were particularly significant in the case of iodine vapour excited by external sleeve electrodes connected to the secondaries of an H T transformer The current (i) was observed with a mirror galvanometer actuated by a diode and also with a cathode ray oscillograph connected serially with the former in the tube circuit Table I records one typical series of results The relative Joshi effect $\%\Delta i = 100\Delta i/i_D$ where i_D is the current in dark and Δi its change (usually though not invariably decrease) on irradiation Joshi[1] using h f discharges in chlorine Tewari[2] and Deshmukh[3] using commercial frequency discharges in iodine vapour observed a fairly pronounced positive effect at low potentials and its inversion by increasing the potential the familiar Siemens ozonizer constituted the discharge tube in their experiments The present results using sleeve excitation show the production of a large positive Joshi effect just near the threshold potential viz about 0 4 kV On increasing the applied potential by 0 07 kV i e by about 17 per cent it is remarkable to see the effect changing sign and yielding about 66 per cent negative Joshi effect This last increases (numerically) to a maximum about 73 per cent for the same rise in applied potential and then diminishes progressively

TABLE I — JOSHI EFFECT IN IODINE VAPOUR

kV	i_D	i_L	Δi	$\%\Delta i$
0 4_0	8	21	+ 13	+162 5
0 4_7	98	33	− 65	− 66 3
0 5_5	143	38	−105	− 73 4
0 6_4	173	46	−127	− 73 4
0 7_3	190	53	137	− 72 1
0 8_5	208	58	150	− 72 1
0 9_5	218	63	−155	− 71 1
1 0_7	220	66	−154	− 70 0
1 1	218	70	−148	− 67 9
1 2_5	228	76	−152	− 66 7
1 4_5	231	89	−142	− 61 4
1 6_7	231	100	−131	− 56 7
2 1_0	230	110	−120	− 52 2
2 4_5	230	113	−117	− 50 8
2 6_7	203	113	− 90	− 44 3

A study of the wave form of the discharge current i_D and that under light i_L was next undertaken Fig 1 is a representative group of oscillograms obtained in dark and in light for the potential range 0 4 to 1 0 kV when the relative Joshi effect $\%\Delta i$ varies appreciably Oscillograms corresponding to large applied potentials (not shown) differed from those in Fig 1 chiefly in one respect The number of high frequency (h f) pulses increased markedly rapidly and tended to be crowded with increased applied potential As the value of the discharge current was low and the regime markedly unstable the corresponding current structure on the C R O at potentials less than 0 4 kV was too flickering for delineation It was seen however that at

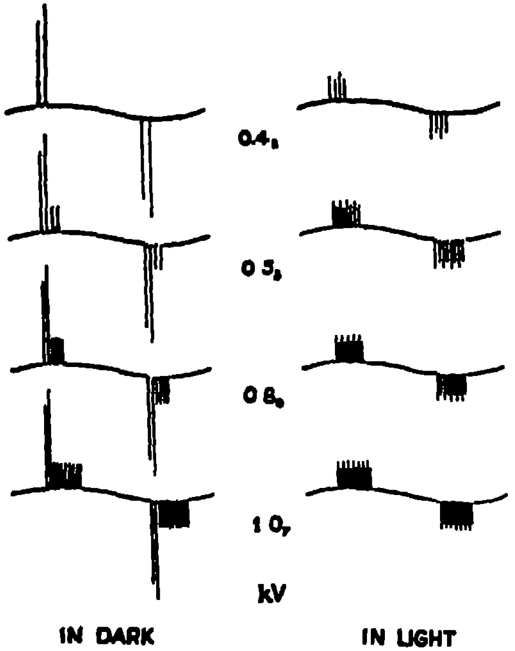

FIG 1 — OSCILLOGRAMS IN THE DARK AND IN LIGHT FOR THE POTENTIAL RANGE 0 4 TO 1 0 KV

these low potentials causing the positive Joshi effect the influence of irradiation was chiefly to stabilize the h f pulses It is now seen that as the potential is increased the number of high frequency pulses (say in dark) increases their amplitudes however remain sensibly unaltered A diode measures the overall current whose magnitude depends almost entirely on the number and the amplitude of these h f pulses It is instructive to observe that the effect of light investigated in various visible spectral regions is to cause two *simultaneous* changes both instantaneous and light reversible (a) a decrease in the amplitude of some of these h f pulses but (b) increase in their total number An examination of a number of oscillograms of which Fig 1 is typical undertaken to obtain more information about (a) has revealed that the amplitude reduction on irradiation is apparently linked with alternate h f pulses which is suggestive The amplitude reduction (a) has been observed in these laboratories and elsewhere in numerous system showing $-\Delta i$ Now $-\Delta i$ would be reduced (numerically) due to the co-occurrence of (b) which *per se* should cause the positive Joshi effect The net influence of light under any given circumstances would therefore depend on the resultant of (a) and (b) Essentially similar results have been observed in a number of other media and markedly in hydrogen under sleeve excitation over a fairly wide range of operative conditions With an ozonizer discharge in chlorine and using as a current detector a special nine valve amplifier connected to a loudspeaker a small positive effect was observed by Joshi and Lad[4] just above the threshold potential V_m which inverted precipitously to the apparently more familiar negative effect due to a very slight increase of the applied potential In a chlorine filled semi ozonizer Joshi[5] observed within a limited range of conditions in the anti phase half wave positions of the oscillograms a simultaneous production of the positive and negative Joshi effect The ready inversion $+\Delta i \rightleftarrows -\Delta i$ and their co occurrence now observed as a methodic feature of a fairly wide range of conditions under sleeve excitation have an obvious interest from the standpoint of a general theory of this phenomenon e g Joshi s theory[5] of its surface photoelectric origin Subsequent studies have shown that compared with other type discharges such as that using an ozonizer which has almost invariably been used during earlier work in this field this *simultaneous* production of $\pm\Delta i$ is more widespread easier of detection and entails a simpler technique under sleeve excitation Presumably this is because at low field strengths which are favourable for the co occurrence of this phenomenon sleeve excitation produces chiefly a surface as distinct from volume conductivity This is illustrated by the general finding that both the magnitude and the above mentioned characteristics (a) and (b) of the Joshi effect become more pronounced by increasing the number of sleeves

My grateful thanks are due to the Council of Scientific & Industrial Research for a grant and to Professor S S Joshi for his valuable advice and guidance throughout the progress of this work

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Preparation & Properties of β-dextrin from Arrowroot Starch

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The preparation of β dextrin from soluble starch (arrowroot) has been described Four samples have been analysed for their phosphorus content iodine number and copper reducing power The rate of hydrolysis of dextrins by paddy malt amylase is influenced by the phosphorus content and iodine and copper numbers of the dextrin and is appreciably slow when these values are high

The dextrins can be fractionated into two components by cold water extraction

A modified iodometric method has been described for determining the copper reducing power of starches and dextrins

AMONG the controversial aspects of the chemistry of β dextrin[1] may be mentioned the functional significance of the dextrin phosphorus[2,3] and the homogeneity of the dextrin itself[1,2,5,6] A reinvestigation of these and allied problems requires as an essential preliminary the characterization of β dextrin obtained under varied conditions of starch hydrolysis These aspects are dealt with in the present communication

Experimental

Hydrolysis of Starch — Lintner soluble starch from arrowroot was used as the substrate Three different preparations of amylase were employed (i) Aqueous amylase was obtained by stirring up ungerminated wheat flour with five times its weight of water and a few c c toluene for 10 hr at 31°C The suspension was then centrifuged filtered and the filtrate preserved under toluene at 5°C (ii) for the preparation of alcoholic amylase the wheat flour was extracted with twice its weight of 20 per cent (v/v) alcohol for 30 min at 31°C (iii) a third extract was prepared by dialysing the stock aqueous amylase for 48 hr against distilled water under toluene at 5°C The concentration of the amylase (expressed in terms of its gm equivalent of wheat flour) was 0 42 per cent of the total volume of the reaction mixture in experiments I IV

Expt No	*Starch conc per cent*	*Amylase extract*
I	2 1	aqueous
II	8 4	aqueous
III	2 1	aqueous (dialysed)
IV	8 4	alcoholic

The hydrolyses were carried out at 38°C in acetate buffer (*p*H 4 6 final concentration 0 01 molar) with the addition of a few drops of toluene For following the course of starch hydrolysis aliquots of the reaction mixture were withdrawn at definite intervals of time After heat inactivation of the enzyme by keeping in a boiling water bath for 5 min the maltose in the aliquots was estimated by copper iodometry[7]

The results of experiments I IV (FIG 1) correspond to typical hydrolysates and refer to ash and moisture free substrate The percentage hydrolysis of starch was calculated as 100x (apparent maltose/theoretical maltose) the equation for the theoretical value being 1 gm starch — 1 055 gm

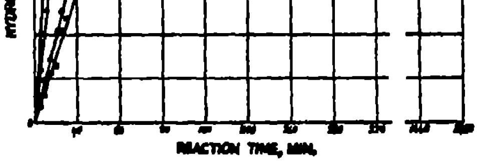

FIG 1 — HYDROLYSIS OF STARCH BY β AMYLASE

maltose It will be observed that the limit values reported here are considerably higher than those considered typical for β amylase action by Blom Bak and Braae[8] namely 53 per cent Among the factors influencing the extent of starch hydrolysis by β amylase are the nature and method of preparation of enzyme and substrate[9 11 13] It is relevant therefore to refer to the high limit values associated with the use of crude wheat amylase[10 14] as also to the peculiarities of arrow root amylopectin[15]

Precipitation of *β-dextrin* — In each of the experiments I IV two digests were used for following the course of starch hydrolysis and two others for the preparation of β dextrin At the end of 48 hr reaction time (by which period the hydrolysates were found to have approached the limit stage) three volumes of 96 per cent alcohol were added to the latter two digests The dextrin which precipitated was removed by centrifuging stirred into suspension in 10 c c water (in experiments I and III) or in 20 c c water (in experiments II and IV) and reprecipitated by the addition of five volumes of 96 per cent alcohol The dextrin was once again separated by centrifuging washed twice with 96 per cent alcohol and dried at 60°C overnight The yield of the dextrin was 0 3 gm (in experiments I and III) 1 3 gm (experiment II) and 1 5 gm (experiment IV) from a reaction mixture of total volume 72 c c These yields of β dextrin were found to suffice for the determination of total phosphorus iodine number and dextrin content

Analysis of Dextrins

One per cent solutions of the dextrins in hot water were prepared For the estimation of dextrin content 10 c c of the dextrin solution were hydrolysed in N/2 hydrochloric acid for 3 hr in a boiling water bath The acid hydrolysate was neutralized with strong alkali the solution made up to known volume and the glucose in aliquots estimated by copper iodometry The glucose value was multiplied by 0 90 to get the dextrin equivalent

Iodine number and total phosphorus of dextrin were estimated by the methods of Saffiec[16] and King[17] respectively

An iodometric adaptation of the technique of Richardson Higginbotham and Farrow[18] was used for estimating the copper reducing power of the dextrins 5 c c of Somogyi s copper reagent[19] and 1 c c of 0·1 per cent glucose solution were added to 4 c c of the dextrin solution contained in a lightly stoppered 8″×1″ Pyrex boiling tube and kept immersed in a boiling water bath for 3 hr The boiling tube was then plunged into water at room temperature (31°C) and maintained therein for 20 min 2 c c of 2 5 per cent potassium iodide were run down the walls of the Pyrex tube without stirring or agitation 2 c c of 20 per cent sulphuric acid were dropped direct into the solution from a wide mouthed pipette with simultaneous agitation so as to mix the contents thoroughly Complete dissolution of the cuprous oxide was ensured by stirring up the sedimented reaction products with a glass rod and washing out the tip of the rod into the solution Titrations were carried out against standard N/200 sodium thiosulphate solution Blanks were run to allow for the thiosulphate equivalent of the added glucose and the reagents

The values reported are the averages of those obtained with two separate preparations of each dextrin

Hydrolysis of Dextrins

For hydrolysis studies a malt preparation from paddy was used Paddy was allowed to germinate for 3 days and the sun-dried malt was extracted with five times its weight of water and a few c c toluene for 10 hr at 31°C The procedure for following the course of dextrin hydrolysis was the same as that employed in the case of starch The reaction mixture was made up of 20 c c 1 per cent dextrin solution 2 c c acetate buffer (*p*H 4 6 0 1 molar) and 2 c c malt extract (= 0 1 gm malt) Fig 2 gives the

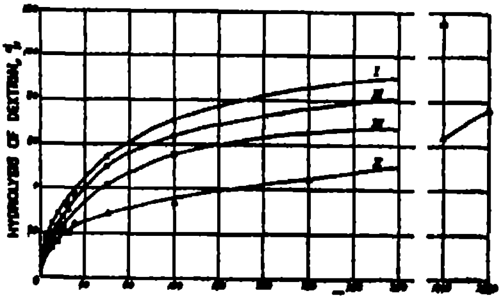

FIG 2 — HYDROLYSIS OF β-DEXTRIN BY MALT AMYLASE

results of the hydrolysis experiments on dextrins I IV It is seen that the initial rates of hydrolysis as well as the final equilibrium values are of the same order as those obtained by Hopkins Bailey and Dolby[8] and much higher than those of Tychowski and Masior[19] who used unbuffered reaction mixtures at *p*H 6 0 and could get a final split of only 28 per cent on a typical dextrin The limit values of maltose obtained in the present case often exceed 100 per cent and point to considerable liberation of glucose[8]

Table I gives the properties of the dextrins and their rates of hydrolysis by malt amylase

TABLE I — ANALYSIS OF DEXTRINS

Dextrin No	Phosphorus* %	Iodine number	Copper number†	% dextrin hydrolysed in 30 min
I	0 18	7 40	46 5	38 4
II	0 22	7 41	49 8	24 6
III	0 18	6 81	45 1	37 1
IV	0 26	7 41	48 9	28 6

* Phosphorus content of arrowroot soluble starch 0 06 per cent.

† Copper number refers to mg of copper reduced by 1 0 gm. starch or dextrin 1 055 gm maltose or 1 111 gm glucose The values for glucose maltose and arrowroot soluble starch were 2708 1379 and 30 48 respectively

The phosphorus content iodine number and copper value of dextrins II and IV are slightly higher than those of dextrins I and III Correspondingly the rates of hydrolysis by malt amylase are somewhat lower in the case of dextrins II and IV The differences between the two groups of dextrins are probably related to the differences in activity of 1 6-α glucosidases of the type mentioned by Myrbaeck and Ahlborg[20] Decreased activity of 1 6-α glucosidases at 8 per cent starch concentration might lead to the formation of β-dextrin with a comparatively higher content of anomalous linkages The possibility has been suggested that phosphorus might be involved in such linkages[1] and it is hence interesting to note that dextrins II and IV prepared from higher substrate levels of starch are relatively richer in phosphorus than dextrins I and III which were prepared from a lower level of starch concentration

Solubility Determination & Fractionation of β dextrins

The solubility data reported here refer to dextrins II and IV which were prepared from 50 gm lots of soluble starch In the final drying of the dextrins it was found convenient to use acetone The yield was 15 gm of dextrin II and 20 gm of dextrin IV from 50 gm of air dry soluble starch

Varying amounts of dextrin were mechanically agitated at 31°C with 10 c c water in test tubes fitted with rubber stoppers After 30 min agitation the suspensions were filtered It was observed that even with the lowest amounts of dextrin used a significant portion of residue could be recovered on the filter paper 2 c c of the filtrate were used for the determination of dextrin by acid hydrolysis Total dextrin was estimated in hot water solutions of the dextrin In Fig 3 the dextrin in 2 c c of cold water extract is plotted against total dextrin

Fig 4 shows the percentage of dextrin in solution when 100 mg of dextrin were extracted for 30 min at 31°C with 10 c c of sodium sulphate solution of varying strength

For the fractionation of dextrins II and IV 500 mg of dextrin were extracted with 50 c c water for 30 min at 31°C The suspension was then filtered 5 c c of the filtrate were used for the determination of iodine number 4 c c for the determination of copper reducing power and 2 c c for acid hydrolysis followed by the determination of iodine number Another 500 mg lot of dextrin was similarly fractionated and 37 5 c c

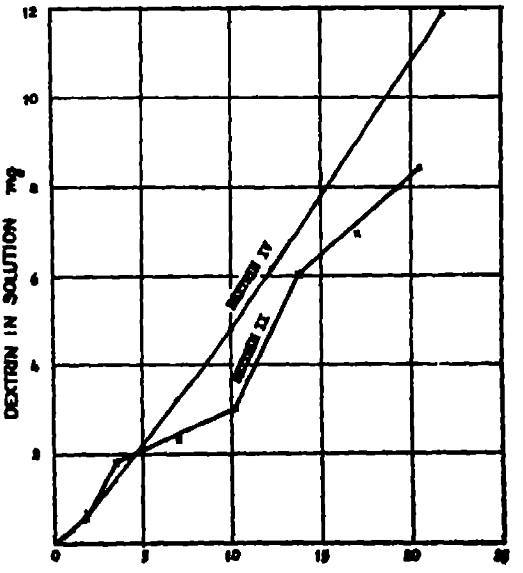

FIG 3 — SOLUBILITY OF β-DEXTRIN IN WATER AT 31°C

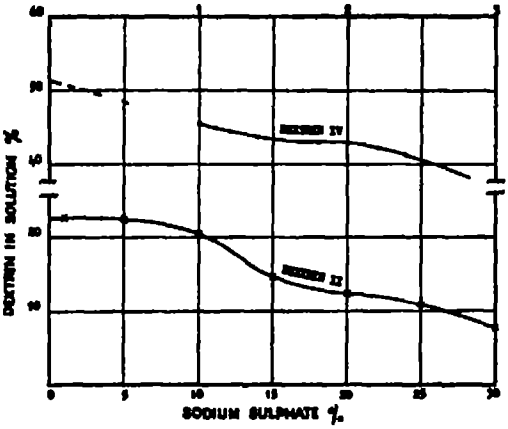

FIG 4 — SOLUBILITY OF β DEXTRIN IN SODIUM SULPHATE SOLUTION AT 31°C

of the filtrate were mixed with 12 5 c c of 20 per cent sodium hydroxide for the determination of optical rotation Values read off from Fig 3 were used for calculating the properties of the cold water soluble fractions of dextrins II and IV reported in Table II

TABLE II — PROPERTIES OF DEXTRINS II & IV & THEIR COLD WATER SOLUBLE FRACTIONS (CWSF)

PROPERTIES	DEXTRIN II	CWSF FROM DEXTRIN II	DEXTRIN IV	CWSF FROM DEXTRIN IV
Iodine number	7 41	19 48	7 41	10 97
Increase in reducing power on acid hydrolysis of dextrin %	1731	701 5	1529	1140
Copper number	49 77	164 2	48 88	119 0
Specific rotation in 5% aq NaOH D line 31°C	+161 1°	+181 1°	+166 1°	+226 6°
* n_{BM}	16	6	16	11
† n_{Sameo}	18	8	16	12

* n_{BM} = chain length calculated from iodine number according to formula of Bergmann and Machemer[4] i.e. n_{BM} = 2000/(17 11 × iodine number of dextrin)

† n_{Sameo} = chain length calculated according to Sameo[16] from data on iodine consumed by dextrin before and after acid hydrolysis.

The data presented here on the solubilities of dextrins are not sufficiently extensive to warrant any conclusions on the number of components in the dextrins still they are enough to show that the dextrins are not chemically homogeneous The results of the fractionation experiments strikingly confirm the heterogeneity of the dextrin preparations used The cold water soluble fraction possesses a much higher copper reducing power and iodine number than the original dextrin in both the cases (TABLE II) The specific rotations of the original dextrin and the cold water soluble fraction are also widely different This is a clear evidence that each of the limit dextrins investigated is a mixture of at least two distinct polysaccharide components The more soluble component is of lower molecular complexity as judged from its reducing power A similar relationship between solubility and molecular weight has been reported of starches by Richardson *et al*[15]

It is also pertinent to note that Haworth and co workers[5,6] have recorded experimental observations regarding dextrins prepared by them which definitely point to the heterogeneity of their specimens but they do not appear to have stressed their significance Thus depending on the method of acetylation one or two acetates could be obtained from the same and apparently homogeneous dextrin[6] Further the dextrins would not give clear aqueous solutions in the cold The possibility of fractionating β dextrin with cold water has been demonstrated in the present work it would therefore seem to be more appropriate to investigate the question of homogeneity by physico chemical techniques than to place absolute reliance on the methylation method of end group assay

Summary

1 Four specimens of β-dextrin have been prepared from arrowroot starch under different experimental conditions Their phosphorus content iodine number copper reducing power and rates of hydrolysis by malt amylase have been determined Of the four dextrins studied two with the higher phosphorus content iodine number and copper number were hydrolysed more slowly by malt amylase than the other two

An iodometric adaptation of the technique of Richardson *et al*[15] has been described for the determination of copper reducing power of starches and dextrins The values obtained by this method are consistent with that given by determination of iodine number

2 Two different preparations of β-dextrin have been studied in regard to their solubility behaviour Each of these preparations has been separated into two distinct components by fractionation in cold water In both the

cases the more soluble component has been shown to be of relatively lower molecular complexity

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Utilization of Castor Seed Cake

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Conditions for the extraction of castor seed proteins from defatted cake have been standardised Extraction of cake (1 part) with 0 20 per cent sodium hydroxide solution (20 parts) at 60°C for 30 min and precipitation of proteins by acetic acid or sulphur dioxide gives a product suitable for the preparation of distempers oil bound water paints adhesive compositions and moulded products

INDIA produces 64 00 000 tons of oil seeds annually (1944) of which 1 14 000 tons are castor seeds The oil seed cakes are mostly used as fodder or fertilizer Castor seed cake whose production is estimated as 66 000 tons per annum cannot be used as fodder due to the poisonous constituents present in it and is therefore mainly used as a fertilizer for sugarcane and other crops Unlike other oil seed proteins castor cake proteins have not been investigated to any great extent An excellent review of the castor seed cake and its uses has been given by Jones[1] The average analysis of defatted castor meal shows 12 4 per cent globulins 3 85 per cent proteoses 1 5 per cent toxalbumin ricin and 1 8 per cent pentose proteins

The suitability of castor cake proteins for the production of distempers plastics adhesives and fibres has been investigated and the results are presented in this paper

Isolation of Proteins

Analysis of Cake — Castor seed cake was first crushed to 4 mesh in a jaw crusher and then disintegrated in a laboratory Raymond screen mill The cake powder had a bulk density of 0 7 gm /c c and gave the following proximate analysis moisture 11 25 per cent fat 6 2 per cent ash 6 27 per cent, and nitrogen 4 582 per cent As the various fractions obtained by the screen analysis of the powder gave the same values for the amount of nitrogenous material peptized by 0 2 per cent NaOH (76 98 per cent) the whole unfractionated cake powder was used in this investigation

Defatting of the Cake Powder — The relative efficiency of benzene benzene methyl alcohol azeotrope industrial methylated spirits and *n* hexane for defatting the cake was investigated Benzene was found to be the ideal solvent for the purpose as it causes the least denaturation of proteins as indicated by the extraction values by 10 per cent sodium chloride (62 14 per cent N) and is readily available in India Analysis of the benzene extract was acid value 145 1 mg KOH/gm sap value 184 0 mg KOH/gm hydroxyl value 145 2 mg KOH/gm

Extraction of Proteins — The defatted cake powder was air dried for 18 24 hr and all traces of residual benzene were removed under vacuum The extraction of proteins by sodium chloride sodium bicarbonate sodium sulphite borax and sodium hydroxide solutions was studied in detail Good yields were obtained by extracting the cake powder with 0 2 per cent sodium hydroxide (20 c c per gm of powder) The optimum temperature and time of agitation are 60°C and 0 5 hr for the maximum extraction of protein (88 86 per cent of the total nitrogen) The sodium hydroxide solutions are extremely slow to filter and a systematic investigation showed that the rate of filtration can be considerably enhanced without in any way diminishing the yield of proteins by diluting the solution with three times its volume of water alternately the decanted solution together with washings can be clarified by centrifuging

Precipitation of Proteins — The proteins in solution were precipitated by adding dilute acid and adjusting the *p*H to the isoelectric point Acetic acid and sulphur dioxide were found suitable for the purpose Proteins obtained by precipitation with alcohol do not easily go into solution in different peptizing agents The properties of proteins isolated by different methods are given in Table I

The viscosities of the various protein samples in 0 2 per cent carbonate-free sodium hydroxide solution at 25°C using standard Ostwald viscometer[8] were determined The specific viscosities and reduced viscosities at various concentrations were calculated and plotted against concentration as shown in Figs 1 and 2 A sample of commercial acid casein purified by repeated washing with water and separation from extraneous matter by decantation and dried by the usual method has been included for comparison

It is seen from Fig 2 that the specific viscosity of castor cake proteins varies almost linearly with concentration below 1 per cent The intrinsic viscosity is therefore given by the slope of the specific viscosity-concentration curve At concentrations higher than 1 0 per cent however the straight line relationship does not hold good although it does in case of casein (FIG 1) Castor cake protein No 7 has an intrinsic viscosity of the same order as that of acid casein indicating the possibility of obtaining a castor cake protein fraction having properties comparable with those of acid casein

It is interesting to note that Staudinger s equation

$$\eta_{sp} = KMC$$

where η_{sp} = specific viscosity M = molecular weight C = concentration in gm /100 c c

TABLE I — PROPERTIES OF ISOLATED PROTEINS

No.	Peptizing agent	Precipitating agent	Yield %	Nitrogen content %	Ash content %	Intrinsic viscosity 100 c.c./gm.
1	10% NaCl	Alcohol	15 0	14 27	6 70	Partly insoluble
2	do	Acetic acid	10 2	15 01	0 615	0 128
3	do	Sulphur dioxide	10 0	15 68	0 500	0 260
4	do	Acetic acid at *p*H 5 5	2 0	15 24		0 145
5*	do	Acetic acid at *p*H 4	4 0	15 22	4 62	0 142
6*	do	Acetic acid at *p*H 3	4 9	15 09		0 125
7	0 2 % NaOH	Acetic acid at *p*H 7	16 0	15 68	1 60	0 212
8	do	Acetic acid at *p*H 3	18 2	14 68	2 58	0 197
9	do	Sulphur dioxide	18 0	15 07	1 80	0 168
10	0 4 % Na_2SO_3	do	19 5	14 94	0 5	0 160

*Sample No. 5 is obtained by acidification of the filtrate and washings from sample No 4 while sample No. 6 is similarly obtained from No. 5

K = constant holds good at concentrations below 1 per cent Hence the determination of viscosity at any one concentration below 1 per cent is needed to determine the molecular weight of the protein fraction provided the constant K has been previously determined

Application of Castor Cake Proteins

Coating Compositions — Work done in this laboratory on the raw materials easily available in India for use in coating compositions has shown that a mixture of pigments consisting of 48 per cent whiting 32 per cent barytes 16 per cent china clay and 4 per cent asbestine (with a small quantity of body pigments for the adjustment to standard whiteness) gives on the whole a better performance than the usual composition for a distemper based on casein This improved formulation of pigments is used throughout the work with castor cake proteins in coating compositions

Castor seed cakes either in the finely powdered form or its fractions passing through (200 mesh screen) were found unsuitable for producing a good grade distemper The alkali extracts of the cake powder were likewise unsuitable for direct use

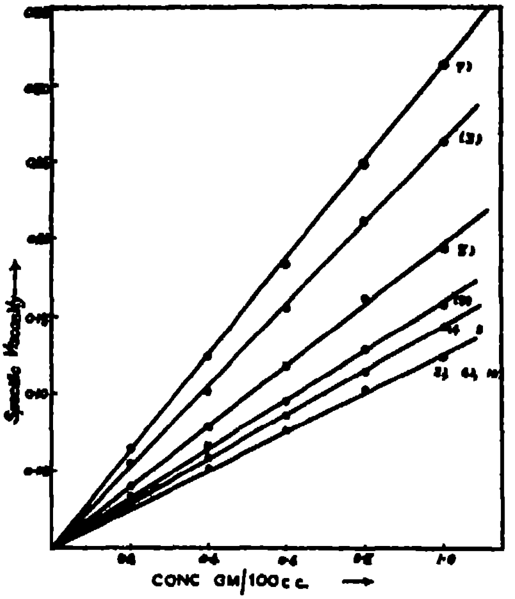

FIG 2 — VARIATION OF SPECIFIC VISCOSITY WITH CONCENTRATION OF CASTOR PROTEIN SAMPLES (2) (10)

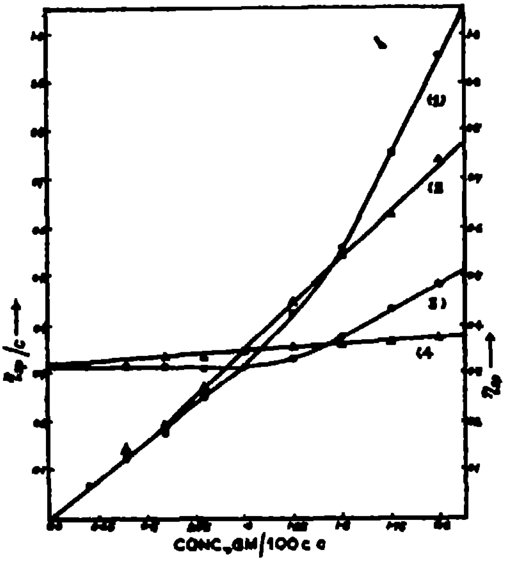

FIG 1 — VARIATION OF SPECIFIC VISCOSITY AND REDUCED VISCOSITY WITH CONCENTRATION OF CASEIN AND CASTOR PROTEINS (SAMPLE No 7) (1) AND (2) η_{sp} *vs* CONCENTRATION (3) AND (4) η_{sp}/C *vs* CONCENTRATION Δ CASEIN O CASTOR PROTEINS

The following general procedure was adopted for the preparation of distempers The proteins in the wet state (10 per cent solids) were dissolved in aqueous sodium hydroxide (5 per cent) and ground with the above pigment mixture along with small quantities of phenol as preservative and turpentine as foam inhibitor

Two coats of the various distemper samples were applied to a previously prepared wall surface at intervals of 1 hr The brush ability of the distemper while applying colour smoothness uniformity durability rub resistance washability and water resistance of the coating and failures such as checking chalking cracking etc were recorded in each case

The performance of the distempers from proteins obtained from undefatted and defatted cake powder were of the same order The addition of small quantities of aluminium sulphate was found to enhance the smoothness durability water resistance and non-chalking characteristics of the coatings But chromium salts effective in insolubilising glue films and lime and particularly useful in hardening casein films were found to have no appreciable effect on castor cake proteins on the other hand lime produced inferior coatings with enhanced chalking The distemper coatings which were ordinarily off coloured could be adjusted to standard whiteness by the addition of appropriate quantities of body pigments like titanium dioxide lithopone zinc oxide etc The amount of body pigments could be reduced to nearly half when sulphur dioxide was used as the precipitant for the proteins instead of acetic acid The final formula adopted for distempers from castor cake proteins is as follows

		Parts
1	Whiting	42 2
2	Barytes	19 4
3	China clay	14 1
4	Asbestine	3 5
5	Titanium dioxide	7 9
6	Zinc oxide	0 9
7	Castor cake proteins	10 0
8	Caustic soda	1 0
9	Phenol or other preservative	0 2
10	Turpentine or other foam inhibitor	0 3
11	Aluminium sulphate	0 5

The wet proteins isolated by the caustic soda sulphur dioxide method pressed to remove excess of water was dissolved in a given quantity of caustic soda (5 per cent solution) ground with phenol turpentine and aluminium sulphate with the minimum amount of water The dry blend of pigments were then ground with the above solution to a thick paste which can be marketed as such in closed containers or used by thinning it with the requisite quantity of water

The distempers in the paste form have good keeping qualities they have been stored for more than a year without any appreciable deterioration They give dead white smooth non chalking coatings having good resistance to dry rubbing moderate washability durability but only limited resistance to wet rubbing

Tempera or oil bound distempers prepared from castor cake proteins give excellent performance Stand oil with 0 02 per cent cobalt was found to give better results than raw or boiled linseed oil 50 per cent of oil on the dry weight of proteins gave good results but twice the above quantity was necessary to give sufficient resistance to water for outdoor use The fully developed formula was as follows

		%
1	Proteins	10 0
2	Sodium hydroxide	1 0
3	Phenol or salicylic acid	0 25
4	Pine oil or turpentine	0 60
5	Linseed oil Stand oil of viscosity 4-7 p with 0 02 per cent cobalt	10 0
6	Aluminium sulphate	0 5
7	Gum tragacanth	0 25
8	Whiting	37 10
9	Barytes	17 30
10	China clay	12 40
11	Titanium dioxide	6 70
12	Zinc oxide	0 80
13	Asbestine	3 10

The wet proteins are dissolved in a minimum quantity of water and phenol turpentine and aluminium sulphate and gum tragacanth are added and thoroughly mixed The oil is then added and the mixing continued until a homogeneous emulsion is obtained The emulsion is then gradually added to the dry blend of pigments in a pug mill or other suitable mixer for better dispersion and homogeneity it may be necessary to grind the paste by passing it once through a triple roller or stone mill The tempera so prepared have the same properties as the distempers in use with the added advantage of improved resistance to water and wet rubbing

The dead white distempers or tempera prepared as above may be adjusted to any shade of colour by incorporating alkali resistant inorganic or organic pigments but when the organic pigments are to be used lithopone or zinc oxide should be preferred to titanium dioxide because of the blanching effect of the latter

Plastic Compositions — The production of resinoid plastics using castor cake powder either defatted or otherwise with phenol formaldehyde resins was not encouraging as the mouldings produced were very brittle and do not take high polish The proteins however could be used along with resins and wood flour to produce mouldings having good

TABLE II — PROPERTIES OF PLASTIC MOULDINGS FROM CASTOR CAKE PROTEINS

No	Method of preparation of proteins	Water soluble %	Water absorption %		
			24 hr	48 hr	20 days
1	0 2% NaOH and acetic acid	4 128	18 7	20 06	23 4
2	0 2% NaOH and $Al_2(SO_4)_3$	3 068	11 88	16 67	20 08
3	0 2% NaOH and SO_2	5 086	13 17	18 93	19 86
4	0 2% NaOH and SO_2 for 24 hr	5 100	12 18	17 81	18 30
5	0 2% NaOH and SO_2*	5 280	38 95	45 63	46 27

NOTE The mouldings showed a uniform shrinkage of 9 6 per cent

* Moulded along with 5 per cent hexamethylene tetramine instead of formalin treatment

resilience and toughness but the surface crazing and high water absorption of the moulded products make them unsuitable for the manufacture of plastic products and electrical accessories Plastic products from castor seed cake proteins were similar to those prepared from casein The protein curd dried to a moisture content of 30 per cent was moulded under 500 p s i at 95°C The moulded pieces were steeped in a 5 per cent formalin bath at *p*H 5 for 7 days and dried at 95°C The shrinkage and water absorption[3] of some samples are given in Table II

Attempts to harden the mouldings *in situ* with hexamethylene tetramine were unsuccessful and there was a considerable decrease in cohesion when proteins were pretreated with formaldehyde Proteins obtained from defatted or undefatted cake produced mouldings with like properties A slight reduction in water absorption was observed when aluminium sulphate was used as a precipitant for proteins instead of sulphur dioxide or acetic acid The mouldings produced were almost dark in colour and only slightly transluscent but thorough blending of the proteins while wet with 10 per cent titanium dioxide and 10 per cent glycerine improved the colour to a great extent showing the possibility of tinting the plastics to any required shade

The plastic compositions possess low cohesion and cannot be extruded into rods and tubes like casein The material can however be made into sheets by pressing in frames between hot plates at 500 p s i and 95°C Buttons and dress ornaments can be punched from the sheet while still wet either before or after treatment with formaldehyde These treated and dried mouldings have nearly the same resilience toughness shrinkage and water absorption as those of casein and with a judicious modification of the processing technique can be employed at least partly to replace casein plastics.

Attempts to improve cohesion of the plastic compositions by treatment with either alkalies or acids were unsuccessful the proteins after such treatment showed a marked tendency towards warping during drying

Wood Adhesives — Work carried out at the Indian Forest Research Institute Dehra Dun[4] has shown that the lime silicate casein formula (cold pressing) evolved at the Madison Laboratories and Smith and Max formula for soyabean proteins (hot pressing) give suitable adhesive compositions with castor seed cake proteins This work relates to the use of proteins from the undefatted castor seed cake The present investigation however shows the amount of improvement in the adhesive strength obtainable by defatting the cake

The dried castor cake proteins not being readily dispersible the wet protein curds were used in the usual formulations as indicated below

I Lime silicate Formula

1	Proteins	100 parts (dry basis) 400 parts (wet basis)
2	Lime (CaO)	32
	Water	100
3	Sodium silicate (Na_2O SiO_2=1 3 25)	70 parts
4	Copper sulphate	3 parts
	Water	30 parts

The wet proteins were ground with milk of lime and sodium silicate and copper sulphate were further incorporated The composition was diluted and applied to box wood (pine) pieces which were pressed at 200 p s i at room temperature for 18 20 hr

II Smith & Max Formula

1	Proteins	100 parts (dry basis) 400 parts (wet basis)
2	Trisodium phosphate	10 parts
3	Ammonia (0 88)	32 parts
4	Formaldehyde (37% neutral)	100 parts

The wet proteins were dispersed in 10 per cent solution of trisodium phosphate and ammonia was added Formaldehyde was incorporated carefully with agitation The boxwood (pine) pieces joined with the adhesive were pressed at 135°C under 300 p s i for 15 min

The shear strengths of the glue joints were determined using the standard Dillon tester The shear strengths obtained for various adhesives based on castor cake proteins along with that for standard acid casein are given in Table III

The above results indicate that a good deal of improvement in adhesive strength can be obtained when the cake proteins leached with 0 25 per cent $NaHCO_3$ solution are used The leaching process removes the residual fats *which are already hydrolysed* As this avoids the costly and involved process of defatting the cake with a solvent the loss of 5 per cent of the proteins during leaching will not materially affect the cost to any great extent The Smith and Max formula (hot pressing) gives consistently high values of adhesive strengths Thus castor cake proteins isolated from the un defatted cake powder after a preliminary leaching with sodium bicarbonate solution can be recommended in the formulation of wood adhesives by the Smith and Max method

Fibres — The proteins isolated in the wet state from the defatted castor seed cake by the sodium hydroxide-sulphur dioxide method were directly used in the preparation of fibres A good grade of commercial acid casein was used for comparison 10 per cent solution of the proteins in 0 25 per cent aqueous sodium hydroxide with 1 per cent oleic acid and 1 per cent sodium aluminate was prepared and after ageing and removal of air bubbles it was extruded through a fine orifice into a coagulating bath containing 2 per cent sulphuric acid and 15 per cent sodium sulphate The extruded fibres were thoroughly washed and then treated with 5 per cent formaldehyde solution The fibres so obtained were comparable with those made from acid casein under similar conditions apart from their brownish shade Although the castor cake proteins show promise as a potential raw material for the manufacture of textile fibre investigations on a pilot plant scale have to be carried out before any final recommendation can be made

Summary

1 Benzene is suitable for defatting the commercial castor seed cake Proteins from the defatted as well as undefatted cake are best extracted with 0 2 per cent sodium hydroxide at 60°C for 0 5 hr Either acetic acid or sulphur dioxide can be used for the precipitation of proteins Under suitable conditions it is possible to isolate proteins having the same intrinsic viscosity as that of acid casein

2 Excellent distempers and oil bound water paints can be formulated from castor seed cake proteins

3 The proteins in the wet state with 10 per cent titanium dioxide and 10 per cent glycerine can be employed to produce plastic products having properties similar to casein plastics

4 Superior wood adhesives can be prepared from proteins of castor seed cake

5 Castor seed cake proteins show promise as a source of textile fibres

TABLE III — SHEAR STRENGTH OF GLUE JOINTS

No.	PROTEIN USED	LIME SILICATE FORMULA (COLD PRESSED)			SMITH & MAX FORMULA (HOT PRESSED)		
		Dry strength, p.s.i.	Wet strength p.s.i.	Wet strength % of dry	Dry strength p.s.i.	Wet strength p.s.i.	Wet strength % of dry
1	Acid casein	434 (5)	150 (3)	34 56			
2	Proteins from undefatted cake powder	242 (5)	90 (3)	37 18	329 (4)	92 (3)	27 97
3	Proteins of the cake powder leached with 0 25% $NaHCO_3$	255 (4)	110 (2)	43 14	462 (4)	155 (3)	33 55
4*	do	290 (4)	120 (4)	41 38	550 (3)	177 (3)	32 18
5	Proteins of the cake defatted with benzene	— †	— †	— †	462 (3)	137 (3)	29 66

NOTE — (1) The figures in brackets show the number of specimen samples tested.
(2) For finding out the wet strengths, the test pieces were boiled vigorously for 4 hr in water cooled and tested.
* The proteins were precipitated with hydrochloric acid in this case. In all other cases acetic acid was used.
† The samples prepared opened out due to defects in the wood not detected beforehand

The castor seed cake powder has got a characteristic action on the human respiratory system and due precautions have to be taken in the handling of castor cake powder particularly during disintegration

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Studies on Calcium Gluconate: Part I—Production from Dextrose

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An electrolytic process for the production of calcium gluconate from dextrose has been described The following operating conditions have proved satisfactory size of electrolytic cell, 20″×20″×12″, 6 pairs of graphite electrodes, 12″×7″×½″ separated by ¼″ wooden separators, dextrose, 28 lb in 60 litres of water, sodium bromide, 3 lb, calcium carbonate, 8 lb ; current, 25 amp /5V, temperature, 30° to 35°C ; time, 58 to 60 hr A yield of 80 per cent on the weight of sugar is reported

A NUMBER of chemical methods are available for the preparation of gluconic acid and calcium gluconate by mild oxidation of dextrose or materials which yield dextrose on hydrolysis Gluconic acid was first prepared by Hlassiwetz and Haberman[1] using chlorine as the oxidizing agent Of the earlier workers Kiliani[2] and Herzfeld[3] used bromine Haberman and Hoenig[4] used cupric hydroxide and sodium hydroxide Tarugi and Nicchiotti[5] alkaline ferricyanide More recently Herzfeld and Lenart[6] developed an improved method using bromine Kiliani[7] and Pichon[8] have suggested further improvements Goebel[9] studied the oxidation of glucose in alkaline solutions of iodine and also the preparation of hexonic acids[10] by the oxidation of aldoses with barium hypoiodite Hoenig and Ruzicka[11] used barium hypobromite for oxidizing *d*-glucose to gluconic acid Sandoz[12] obtained several patents for the manufacture of calcium gluconate by the oxidation of glucose with chlorine in the presence of potassium bromide and alkaline earth carbonates Bert[13] prepared gluconic acid by the oxidation of glucose with yellow oxide of mercury Van der Lande[14] obtained a patent for oxidation of glucose with mixtures of bromides and chlorates in an acid medium and Max Busch[15] for oxidation of dextrose with oxygen in the presence of palladium as catalyst Hoffman la-Roche[16] patented a process for the preparation of *l* gluconic acid by the catalytic hydrogenation of *d* glucuronic acid in the presence of nickel as a catalyst Pasternack and Brown[17] obtained a mixture of calcium-*l*-gluconate and *d* gluconate by hydrogenation of calcium-5 keto-gluconate

Loeb[18] first attempted the electrolytic oxidation of glucose in sulphuric acid medium but obtained mostly oxalic acid as the final product Isbell and Frush[19 21] developed an electrolytic process for the oxidation of glucose and other aldoses in which the bromine used for oxidation was continuously regenerated during electrolysis Fink and Sumners[22] studied the same method in somewhat greater detail *Rohm & Haas Co*[23] patented the use of insoluble anodes for electrolysis Kiliani[24] considered that potassium bromide gives better results than potassium chloride Szware[25] gives the optimum conditions for maximum yield of calcium gluconate as low temperature (10°-15°C) and a current density of 3 amp / sq dm.

The production of calcium gluconate from raw materials hitherto unexplored has been systematically examined and the various practical and theoretical aspects of manufacture are discussed in this paper

Electrolytic Oxidation of Dextrose — Electrolytic oxidation of dextrose has a great advantage over chemical methods in that a small amount of oxidizing agent present in the electrolyte is continuously regenerated by electrolysis Usually a solution containing dextrose (to be oxidized) and potassium bromide is electrolysed at a voltage of 4 to 6 volts using graphite electrodes The bromine evolved oxidizes the dextrose to gluconic acid and gets itself converted to potassium bromide which in turn generates bromine on electrolysis Thus a small amount of potassium bromide in solution is repeatedly utilized for the oxidation of the glucose

Experimental

All laboratory experiments were carried out in a 3 litre glass container fitted with two pairs of Acheson graphite electrodes 8″ × 4½″ × ½″ A glass stirrer with wooden upthrust vanes was employed Pure anhydrous dextrose potassium bromide and calcium carbonate were used

In all the runs 450 gm of pure dextrose were dissolved in water and the solution made up to a volume of 2 5 litres and 125 gm of calcium carbonate added A total current of 150 amp /hr was passed in each case The temperature of the cell was kept constant by external cooling The source of current was a 6 volt storage battery which was continuously charged from the D C mains The results are summarized in Tables I to IX

TABLE I — EFFECT OF ELECTROLYTE (KBr) CONCENTRATION ON THE YIELD OF CALCIUM GLUCONATE

Current density c 1 3 amp /sq dm temp of the cell 26°C distance between electrodes ½

KBr %	Volts	Cal. gluconate formed %	Cal. gluconate crystallising out %
0 5	20	73 3	51 6
1 0	9 5	77 0	52 5
1 5	7 2	82 5	54 1
2 0	6 0	86 3	55 0
3 0	5 0	88 3	54 1
5 0	4 2	88 3	50 8
10 0	3 4	87 6	40 9

TABLE II — EFFECT OF ELECTROLYTE (KBr) CONCENTRATION ON BROMIDE LOSS

Current density c 1 3 amp /sq dm. distance between electrodes ½″ temp 26 C

Initial conc of KBr %	Final conc of KBr, %	Bromide lost %
10	9 6	4 0
5 0	4 61	7 8
3 0	2 60	13 5
2 0	1 63	18 5
1 5	1 15	23 3
1 0	0 69	31 0
0 5	0 20	60 0

TABLE III — EFFECT OF VARIATION OF DISTANCE BETWEEN ELECTRODES ON THE YIELD OF CALCIUM GLUCONATE

KBr concentration, 2 per cent current density c 1 3 amp /sq dm temp 26 C Acheson graphite electrodes employed

Distance between electrodes, in.	Voltage	Cal. gluconate formed gm.	Yield %
¼	4 7	470	78 3
½	5 5	505	84 2
¾	7 0	530	88 3
1	8 4	525	87 5
1½	10 0	530	88 3
2	12 0	522	87 0

TABLE IV — EFFECT OF TEMPERATURE ON THE YIELD OF GLUCONATE & LOSS OF BROMIDE

Distance between electrodes ½ KBr concentration 2 per cent current density c 1 3 amp /sq dm. Water was circulated in the outer jacket at the desired temperature and the temperature in the cell did not vary by more than 1 C from the desired temperature

Temp °C.	Yield of cal. gluconate %	Final conc of KBr %	Bromide lost %
20	87 8	1 70	15 0
30	89 4	1 60	20 0
40	86 9	1 52	24 0
50	83 5	1 43	28 5
60	80 2	1 30	35 0
70	78 6	1 10	45 0

TABLE V — CURRENT DENSITY & YIELD OF CALCIUM GLUCONATE

KBr concentration, 2 0 per cent average cell temp, 25°C total current 150 amp /hr Current density was varied by altering the voltage across the cell

Current density amp./sq dm	Voltage	Cal. gluconate formed gm	Glucose consumed gm.	Yield of cal. gluconate %
0 8	3 7	535	450	89 2
1 3	6 0	530	450	88 3
2 0	9 0	525	443	87 5
3 0	13 5	510	450	85 0
5 0	22 3	470	450	78 6
6 5	30 0	410	450	68 3

TABLE VI — EFFECT OF REVERSAL OF CURRENT AT INTERVALS

Time between reversals min.	Cal. gluconate formed gm	Yield of cal gluconate %	Bromide lost %
5	530	88 3	18 0
30	525	87 5	20 0
60	522	87 0	20 0
180	525	87 5	21 2
360	530	88 3	21 6

TABLE VII — RATE OF STIRRING & YIELD OF CALCIUM GLUCONATE FORMED & CRYSTALLIZED

Total current 150 amp /hr

R P M	Cal. gluconate formed gm	Cal gluconate crystallising out gm	Yield of cal gluconate %
60	350	120	58 3
120	410	215	68 5
300	520	335	86 6
700	530	340	88 3

TABLE VIII — EFFECT OF REPEATED USE OF MOTHER LIQUOR ON CALCIUM GLUCONATE YIELD

Glucose gm	Cal carbonate gm.	Sodium bromide gm	Yield of recrystallised cal gluconate gm	Remarks
450	125	45	260	
300	90	20	250	M L I
250	70	18	236	M L I & II
250	70	18	232	do

M L — Mother liquor

TABLE IX — EFFECT OF INITIAL SUGAR CONCENTRATION ON THE YIELD OF CALCIUM GLUCONATE

Current density 1 3 amp /sq dm temp 30°C KBr 2 per cent volume of solution 2 5 l

Initial glucose conc %	Total amount of glucose gm	Total current passed amp /hr	Cal. gluconate formed gm	Yield of cal. gluconate %
5	125	40	148	88 1
10	250	80	290	86 4
15	375	120	442	87 0
20	500	160	600	89 2
30	750	240	760	74 0

The yield of calcium gluconate is unaffected by the initial concentration of the sugar However with higher concentrations of glucose (above 20 per cent) there is a marked lowering in the yield of calcium gluconate (TABLE IX) With a 30 per cent solution of glucose calcium gluconate started crystallizing out from the electrolytic medium long before all the sugar was oxidized The bulky nature of the salt rendered efficient stirring difficult and the lowering of yield was perhaps mainly due to local over-oxidation near the electrodes Thus a concentration of 18 to 20 per cent glucose appears to be best suited to large-scale practice

The following operating conditions for semi large scale production of calcium gluconate have been employed by us with satisfactory results over a period of five years

(i) Dextrose concentration at the start of electrolysis c 18 per cent
(ii) Initial KBr concentration c 1 8 per cent
(iii) Temperature of the cell during electrolysis 30° to 35°C
(iv) Current density 1 to 1 3 amp /sq dm
(v) Distance between the electrodes 15 to 20 mm
(vi) Voltage across the cell 4 to 6 volts

Semi large scale Production — A wooden cell 20″ square and 14″ tall fitted with a wooden stirrer with upthrust blades and 6 pairs of Acheson graphite electrodes 12″ × 7″ × ½″ was used The electrodes were separated by wooden separators ½″ thick The cell was charged with 60 litres of tap water, 28 lb of anhydrous dextrose 3 lb of sodium bromide and 8 lb of calcium carbonate Sodium bromide was substituted for potassium bromide on a large scale in view of its lower cost and considering the fact that only the bromide ion is concerned in the oxidation of glucose A current of 75 amp at about 5 volts pressure was passed The glucose was oxidized electrolysis was allowed to proceed for 58 to 60 hr after which the contents of the cell were allowed to crystallize the crystals spun and washed in a centrifuge and the crude calcium gluconate recrystallized from hot water The calcium gluconate thus obtained conformed to the B P specification That the salt obtained by electrolytic oxidation was calcium gluconate and no other was verified by preparing the phenylhydrazide of the acid The calcium gluconate prepared using the same mother liquor over and over again gave consistent values for the melting point of the phenylhydrazide, indicating that the glucose was directly oxidized to gluconic acid

The mother liquor and washings were always returned to the cell and calcium gluconate yields of over 80 per cent on the weight of sugar employed have been obtained over a period of several months

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Effect of Heat on Vegetable Oils

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Changes in the physical and chemical properties of coconut castor groundnut, mustard, safflower and linseed oils brought about as a result of heating the oils under varying experimental conditions have been quantitatively determined The oils were heated for 4 hr at 125°C, 200°C and 300°C under (1) ordinary conditions, (2) blowing air and (3) blowing carbon dioxide

THE changes which fixed oils undergo when heated to different temperatures are important in the manufacture of varnishes paints printing inks linoleum and lubricants Coconut castor groundnut, mustard safflower and linseed oils have been heated under different experimental conditions and the changes occurring in their physical and chemical properties are reported in this paper

Experimental

500 gm samples of alkali refined oil were heated in a flask for 4 hr at 125°C 200°C and 275° 300°C under the following conditions (1) ordinary conditions (2) by blowing air or carbon dioxide at the rate of 10 litres an hour through the oils A distillation head was provided for flasks when the oils were heated at 275° 300°C The physical and chemical characteristics of the various samples are recorded in Tables I VI

Discussion

Very little loss in the weight of oils was observed when they were heated at 125° and 200°C while losses were observed in the oils heated at 275° 300°C Greater losses in weight are observed with coconut and castor oils which may be due to the presence of lower fatty acids in the former and due to dehydration of ricinoleic acid chains in the latter There is definite increase in the depth of the colour of the oils as the heating temperature and the period of heating are increased.

The increase in specific gravities and viscosities of the oil samples are highest when

TABLE I — EFFECT OF HEAT ON COCONUT OIL

Characteristics	Original oil	Oil heated at 125°C.			Oil heated at 200°C.			Oil heated at 275°-300°C		
		Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown
Weight gm.		298.0	299.0	297.0	296.0	295.0	296.0	286.0	250.0	252.0
Colour (Lovibond)	0.1*	0.1*	0.15*	0.2*	2.6*	1.0*	3.0* 0.5†	30.0* 2.0†	80.0* 25.0†	40.0* 7.0†
Sp. gr., 40°C.	0.9170	0.9170	0.9189	0.9170	0.9238	0.9209	0.9182	0.9163	0.9234	0.9236
Viscosity 40°C (centistokes)	31.77	32.09	33.16	32.57	34.94	36.1	34.66	41.94	48.65	41.57
Ref ind. 25°C	1.454	1.4542	1.4543	1.4540	1.4545	1.4545	1.4547	1.4555	1.456	1.4540
Peroxide val	4.26	19.53	46.95	30.48	2.43	17.93	10.28	0.96	2.51	6.12
Acid val.	0.35	0.37	0.74	0.46	0.5	1.178	1.073	27.65	16.65	7.82
Sap. val.	259.4	267.4	258.0	262.0	266.9	261.7	265.0	267.1	267.2	267.2
Iodine val (Wijs)	9.32	9.79	8.72	8.34	9.16	8.53	8.53	9.02	7.5	7.96

* Yellow   † Red

TABLE II — EFFECT OF HEAT ON CASTOR OIL

Characteristics	Original oil	Oil heated at 125°C			Oil heated at 200°C			Oil heated at 275°-300°C		
		Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown
Weight, gm.		295.0	296.0	299.0	297.0	298.0	292.0	244.0	230.0	238.0
Colour (Lovibond)	0.5*	0.4*	0.5*	0.6*	0.5*	1.4* 0.2†	2.0* 0.4†	15.0* 1.8†		2.6* 0.8†
Sp. gr., 40°C	0.9608	0.9572	0.9547	0.9562	0.9585	0.9563	0.9562	0.9608	Gel formation took place	0.9445
Viscosity 40°C. (centistokes)	280.16	305.6	311.6	312.7	322.9	347.4	336.5	933.6		597.7
Ref ind 25°C.	1.478	1.4782	1.4780	1.4781	1.4785	1.4782	1.4783	1.4840		1.483
Peroxide val	1.5	1.45	6.14	2.2	2.15	2.72	2.50	1.16		1.80
Acid val.	2.63	2.44	2.73	2.36	2.44	1.99	2.1	17.97		20.72
Sap. val	182.5	186.6	184.1	186.8	186.2	185.1	187.9	210.0		190.1
Iodine val (Wijs)	86.9	86.7	85.17	85.66	80.66	86.9	87.1	92.94		113.4
Acetyl val.	147.6	144.2	147.0	145.5	145.8	145.2	144.8	87.89		18.1

* Yellow   † Red

TABLE III — EFFECT OF HEAT ON GROUNDNUT OIL

Characteristics	Original oil	Oil heated at 125°C.			Oil heated at 200 C.			Oil heated at 275°-300°C		
		Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown
Weight gm		296.0	296.0	296.0	296.0	298.0	296.0	292.0	265.0	280.0
Colour (Lovibond)	0.2*	0.2*	0.25*	0.25*	0.5*	0.5*	0.5*	10.0* 1.2†	16.0* 3.1†	3.0* 0.9†
Sp. gr., 40°C	0.9071	0.9073	0.9080	0.9079	0.9102	0.9120	0.9108	0.9105	0.9234	0.9229
Viscosity 40°C. (centistokes)	42.75	45.04	48.63	46.72	52.94	63.21	50.69	66.75	171.2	86.68
Ref ind. 25°C	1.466	1.466	1.4663	1.466	1.467	1.467	1.4665	1.4665	1.471	1.470
Peroxide val	12.83	10.37	28.48	17.64	8.69	10.57	8.27	3.02	2.52	4.06
Acid val	0.41	0.56	0.55	0.44	0.77	0.63	0.55	0.74	7.34	3.22
Sap. val	193.7	193.3	193.6	193.4	194.9	193.6	194.4	192.0	202.0	200.4
Iodine val (Wijs)	95.7	94.7	95.06	94.95	93.0	94.3	91.24	92.19	88.56	79.16

* Yellow   † Red

TABLE IV — EFFECT OF HEAT ON MUSTARD OIL

Characteristics	Original oil	Oil heated at 125°C			Oil heated at 200°C			Oil heated at 275°-300°C.		
		Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown
Weight gm		296.0	297.0	297.0	296.0	297.0	295.0	296.0	298.0	292.0
Colour (Lovibond)	0.8* 0.2†	2.0* 0.2†	2.4* 0.6†	10.6* 2.0†	9.0* 1.8†	11.0* 2.0†	5.0* 2.0†	60.0* 5.0†	80.0* 10.0†	[illegible] [illegible]
Sp. gr., 40°C.	0.9040	0.9039	0.9060	0.9076	0.9057	0.9122	0.9105	0.9122	[illegible]	[illegible]
Viscosity 40°C. (centistokes)	51.63	52.94	55.06	55.18	60.4	73.79	59.64	123.8	336.6	180.5
Ref ind., 20°C.	1.469	1.469	1.4692	1.4697	1.4692	1.470	1.4705	1.471	1.4745	1.4753
Peroxide val.	13.52	11.53	15.29	20.27	7.01	8.67	5.80	1.77	7.4	5.0
Acid val.	0.36	0.56	0.65	0.43	0.90	0.97	0.65	16.75	12.6	6.16
Sap. val	174.0	173.6	174.1	177.2	174.1	175.7	177.0	177.0	180.0	173.8
Iodine val. (Wijs)	99.02	102.6	96.0	100.7	101.5	102.5	104.1	96.68	79.47	89.66

* Yellow   † Red

TABLE V — EFFECT OF HEAT ON SAFFLOWER OIL

CHARACTERISTICS	ORIGINAL OIL	OIL HEATED AT 125°C.			OIL HEATED AT 200°C.			OIL HEATED AT 275° 300°C.		
		Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown
Weight gm		399 0	397 0	399 0	398 0	395 0	398 0	396 0	370 0	375 0
Colour (Lovibond)	0 3*	0 4*	0 8* 0 3†	0 8* 0 5†	1 1* 0 3†	7 0* 1 7†	6 0* 1 4†	2 8* 0 5†	23 0* 4 6	60 0* 6 0†
Sp gr 40°C	0 9162	0 9171	0 9174	0 9166	0 9195	0 9208	0 9192	0 9278	0 9502	0 9423
Viscosity 40°C. (centistokes)	34 38	35 51	40 59	38 47	41 91	48 09	45 43	124 0	1257 1	380 1
Ref ind 25°C.	1 4740	1 4/40	1 4745	1 4745	1 4745	1 4755	1 4752	1 4772	1 4846	1 482
Peroxide val	20 2	12 3	43 55	41 0	11 0	12 5	20 00	3 1	3 89	4 56
Acid val	0 21	0 24	0 55	0 60	0 37	1 01	0 91	8 4	10 07	4 58
Sap val	193 6	195 9	193 5	191 0	196 7	192 5	196 1	197 3	195 4	201 3
Iodine val (Wijs)	143 3	145 0	141 0	141 2	145 0	138 0	139 4	120 7	104 3	118 7

* Yellow † Red

TABLE VI — EFFECT OF HEAT ON LINSEED OIL

CHARACTERISTICS	ORIGINAL OIL	OIL HEATED AT 125°C			OIL HEATED AT 200°C.			OIL HEATED AT 275° 300°C		
		Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown	Ordinary conditions	Air blown	CO_2 blown
Weight gm		399 0	399 0	398 0	398 0	398 0	396 0	390 0	370 0	370 0
Colour (Lovibond)	3 0* 0 3†	2 0* 0 3†	3 0* 0 3†	2 6* 0 5†	4 4* 0 5†	5 4* 0 6†	3 7* 0 6†	10 0* 1 0†	Gel formation took place after 4 hr heating	15 0* 3 0†
Sp. gr 40 C	0 9244	0 9256	0 9266	0 9241	0 9304	0 9307	0 9265	0 9509		0 9603
Viscosity 40°C. (centistokes)	32 9	34 42	37 94	33 09	46 44	56 1	39 61	511 3		1694 3
Ref ind. 25°C	1 4777	1 4780	1 4806	1 4806	1 4807	1 4787	1 4820	1 4850		1 4896
Peroxide val	28 5	10 0	16 3	12 2	7 81	11 75	12 31	2 2		1 7
Acid val	0 25	0 30	0 47	0 40	0 73	0 75	0 68	6 3		3 2
Sap. val	192 5	196 6	194 1	194 8	206 1	195 4	196 0	195 4		198 2
Iodine val. (Wijs)	178 2	181 6	180 5	180 4	178 1	176 2	176 6	142 5		119 8

* Yellow † Red

heated at 275° 300°C The change in the refractive index has been very little in all cases but there is slight increase in the case of castor oil and linseed oil heated at 275° 300°C The acid and saponification values of the samples increase as the temperature of heating is raised while the iodine value follows the reverse order These changes are greatest at 275° 300°C and may be due to oxidation cracking and polymerization of the oils

Peroxides being unstable bodies break down at higher temperatures and no inference can be arrived at from this value

The air blown oil samples show high specific gravity and viscosity and this is more marked in the case of castor and linseed oils In several cases lower values for specific gravity and viscosity and high acid values have been obtained for oils heated under ordinary conditions at 275° 300°C than when air or carbon dioxide is blown through This may be due to some of the cracked products of low molecular weight remaining in the oil

From the data presented in Tables I-VI it can be concluded that oils with high iodine value should not be employed for lubricating purposes The use of coconut oil and castor oil for lubrication in steam cylinders or in heavy internal combustion engines where high temperatures are encountered may lead to their decomposition and polymerization Groundnut and mustard oils appear to be quite satisfactory for lubricating purposes

Effect of Salts on the Physical Properties of Soils

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The effect of sodium and calcium salts on the physical properties of Roorkee soil (30 per cent clay and 45 per cent sand) has been investigated Sodium salts reduce and calcium salts enhance the liquid and plastic limits and linear shrinkage values of the soil. The density of compaction is not significantly influenced by sodium silicate, lime or calcium carbonate, unless the salts are present in high concentrations.

THE physical properties of soils can be modified by the addition of salts. The effects of salts on the bearing capacity of soils — an important consideration in laying the foundations of a structure — have been investigated by Asghar and Sain[1] The effects of salts on liquid and plastic limits, optimum density and moisture content and linear shrinkage have been investigated in this laboratory with a view to correlate the influence of these factors on the ultimate bearing capacity of soils The results obtained are reported in this paper

Experimental

Roorkee soil containing 30 per cent clay and 45 per cent sand was employed in these studies Samples containing varying amounts of calcium and sodium salts were prepared by mixing salt, soil and water, air-drying the mixture and then sieving through a 40-mesh sieve

The liquid and plastic limits and the plasticity index were determined according to A S T M. methods D423 and 424 — 39[2,3] The method recommended by the U.S Bureau of Public Roads was adopted for the determination of the linear shrinkage Optimum moisture content and the density of the soil were measured by compacting the soil in a cylinder (3" × 2 5" dia), the soil was compacted in one layer, a hammer (6 6 lb) being allowed to drop 25 times through a height of 10" The compacting effort in this case was the same as that obtained in the standard Proctor method

The results of the tests are presented in Tables I and II and Figs 1 and 2

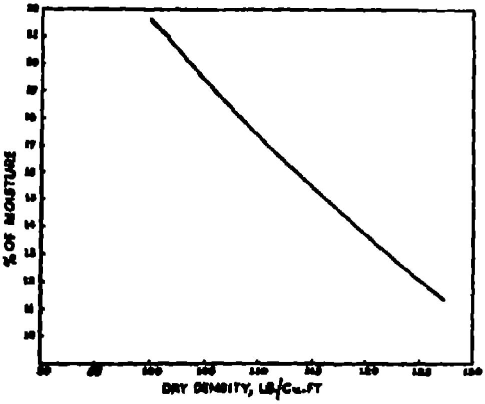

FIG 1 — RELATION BETWEEN OPTIMUM MOISTURE CONTENT AND OPTIMUM DENSITY OF ROORKEE SOIL AS AFFECTED BY THE ADDITION OF SALTS

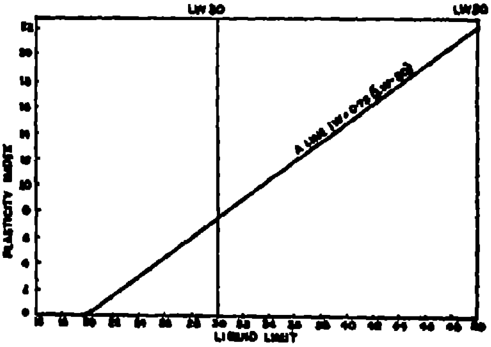

FIG 2 — INFLUENCE OF SALTS ON THE RELATION BETWEEN THE LIQUID LIMIT AND PLASTICITY INDEX OF ROORKEE SOIL.

Discussion

Liquid Limit — The progressive addition of sodium silicate to the soil first decreases the liquid limit up to a salt concentration of 2 per cent and then the value rises (Table I) Similar effects are noticed when sodium carbonate is added to the soil Sodium sulphate and sodium chloride reduce the value slightly while calcium salts increase it Sodium soils have a lower liquid limit than calcium and hydrogen soils (Table II) These results indicate that it is not the exchangeable bases alone that control the liquid limit of a soil but the presence of salts also affects the value

The variations in the liquid limit brought about by the addition of salts to the soil may be due to increased dispersion of the

TABLE I — EFFECTS OF SALTS ON ROORKEE SOIL

Salt	% of salt added	Liquid limit	Plastic limit	Plastic index	Optimum moisture	Optimum density	Linear shrinkage
Sodium silicate	None	38 4	18 4	20 0	12 8	121 0	12 8
	0 5	23 3	16 1	7 2	13 5	121 3	4 9
	1 0	21 5	16 5	5 0	14 5	119 3	3 9
	2 0	21 0	16 8	4 2	16 4	118 6	2 8
	3 0	27 5	21 0	6 5	20 0	104 5	4 2
	4 0	33 3	24 2	9 1	24 7	98 7	4 8
Sodium carbonate	0 0*	35 0	18 4	16 6	15 9	118 8	11 6
	0 5	26 2	16 4	9 8	14 2	118 7	6 5
	1 0	25 0	15 7	9 3	14 4	117 3	6 0
	2 0	30 4	17 3	13 1	14 8	117 0	8 7
	3 0	33 0	17 9	15 1	14 6	117 6	9 4
	4 0	33 5	17 9	15 6	14 8	117 4	9 7
	5 0						
Sodium chloride	0 5	34 5	18 4	16 1	14 8	117 0	10 8
	1 0	34 1	18 0	16 1	14 2	118 0	10 5
	2 0	32 3	18 0	14 3	14 7	117 2	9 6
	3 0	33 2	18 5	14 7	15 1	116 9	9 7
	4 0	33 4	18 5	14 9	15 2	116 7	9 8
Sodium sulphate	0 5	33 8	17 7	16 1	15 1	116 2	9 3
	1 0	31 8	17 4	14 4	14 8	116 8	8 5
	2 0	32 6	17 3	15 3	14 0	117 2	8 7
	3 0	33 0	17 3	15 7	14 9	117 2	8 7
	4 0	33 0	17 5	15 5	15 0	117 0	8 7
Calcium chloride	0 5	35 8	18 9	16 9	14 9	117 4	12 6
	1 0	36 3	18 9	17 4	15 0	116 8	12 6
	2 0	35 4	18 2	17 2	14 9	117 2	12 6
	3 0	35 0	17 9	17 1	15 0	117 2	12 6
	4 0	34 9	18 2	16 7	15 1	116 9	12 6
Calcium sulphate	0 5	35 6	18 5	17 1	15 4	115 0	11 6
	1 0	37 1	19 6	17 5	15 7	114 2	12 1
	2 0	36 9	19 5	17 4	15 4	114 8	11 9
	3 0	36 8	19 2	17 6	15 7	114 3	12 3
	4 0	36 7	18 9	17 8	15 6	114 5	12 4
Calcium carbonate	0 5	35 6	19 0	16 6	15 7	114 3	11 3
	1 0	36 8	19 5	17 3	14 9	115 1	11 2
	2 0	36 6	20 1	16 5	15 1	114 6	11 0
	3 0	36 6	20 3	16 3	15 9	113 7	11 0
	4 0	36 8	20 4	16 4	16 5	112 4	11 0
Calcium oxide	0 5	35 0	18 8	16 2	16 1	114 6	11 6
	1 0	34 9	19 8	15 1	16 2	114 1	9 4
	2 0	35 0	23 5	11 5	17 5	107 5	6 7
	3 0	34 9	24 8	10 1	18 8	105 0	5 5
	4 0	35 4	26 0	9 4	20 4	102 0	4 7

* Untreated Roorkee soil

TABLE II — EFFECT OF EXCHANGEABLE BASES ON ROORKEE SOIL

Soil	Liquid limit	Plastic limit	Plastic index	Optimum moisture	Optimum density	% of clay by disintegration*	% of clay (shaking 15 min in Horlick's shaker)
Sodium soil	29 0	15 3	13 7	14 8	117 5	26 5	26 5
Calcium soil	34 4	18 0	16 4	15 0	116 8	3 5	9 86
Hydrogen soil	35 4	19 2	16 2	16 1	112 9	4 2	9 9
Sodium soil + 5% sodium chloride	34 8	16 9	17 9	14 6	117 8	10 5	23 5
Calcium soil + 5% calcium chloride	35 3	18 9	16 4	15 0	116 7	2 25	4 75
Untreated soil	35 0	18 4	16 6	15 9	118 8		

* The soil was allowed to remain in contact with water for 24 hr and the percentage of clay was determined by the pipette method.

soil particles. When sodium carbonate and sodium silicate are added to a soil in small concentrations they act as deflocculating agents and decrease the value of the liquid limit In larger amounts they favour flocculation and increase the value Calcium salts coagulate the soil particles in suspensions and increase the value of the liquid limit

The plastic limit is controlled both by the exchangeable bases and salts present in the soil Sodium salts depress the plastic limit to a greater extent than calcium salts In general sodium soils have a lower plastic limit than calcium and hydrogen soils Addition of lime enhances the plastic limit to a significant degree

The linear shrinkage of soils is influenced by added salts in the same manner as the plasticity index Addition of small quantities of sodium carbonate and sodium silicate causes the soil compacts to warp Bricks made from Roorkee soil containing 0 5 per cent added sodium carbonate develop cracks when dried in the sun

The density of compaction is not significantly affected by the addition of salts Sodium silicate lime and calcium carbonate lower the density when added in large amounts to the soils (TABLE II) The density of compaction of a soil is controlled by the thickness of the water film surrounding the clay particle In the case of soils containing exchangeable bases in concentrations sufficient to saturate the soil the thickness of the film around the clay particle is low and the density of the soil is high Sodium and calcium soils have a higher density of compaction than untreated and hydrogen soils

The Atterbergs s limits and optimum moisture content of a soil are reported to increase when the density of soil falls[4] Our results are not in accordance with this observation Addition of 2 per cent of sodium silicate decreases both the density and the liquid limit of the soil Similarly addition of lime decreases the density of the soil but has practically no effect on the liquid limit The increase in the density of the soil is accompanied by a decrease in the optimum moisture content The relationship between the optimum moisture content and the optimum density is shown in Fig 1 The influence of salts on the relation between liquid limit and plasticity index of Roorkee soil is represented in Fig 2

The method of classifying soils on the basis of grain size distribution does not give a correct picture of the physical properties of different types of soils Fine-grained soils having the same particle size distribution can differ widely in physical properties The limitations of textural classification of soils have been indicated by the work of Casagranade[5] The results reported (TABLES I and II) indicate that the physical properties of a soil are influenced by the addition of salts

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Letters to the Editor

LOCATION OF UNDULATIONS IN THE F_2 REGION OF THE IONOSPHERE

IT HAS BEEN REPORTED IN A PREVIOUS COMMUNICATION[1] that the abnormal or anomalous multiple reflections from the F_2 region of the ionosphere, observed by pulse transmissions at vertical incidence appear to be very intimately connected with the undulations in the ionosphere As these undulations may at times substantially affect the reception of radio signals, it would be useful to collect the detailed information regarding their formation and other characteristics These undulations generally occur in the evening hours and are associated with rapid fluctuations and general increase in the intensity of the reflected pulses from the ionosphere It should be mentioned that these undulations may be fairly extended in space as their effects have often been observed in our fading records for transmissions from Delhi and at the same time they were found to be present in the pulse observations at vertical incidence at Banaras They may, however, at times be localized in the ionosphere and their duration of existence may vary from several minutes to a few hours The present communication is intended to show the effects of these undulations on the variations of intensity of short-wave radio signals received at oblique incidence and to find their possible positions in the ionosphere

For the above purpose, the observations of fading of received signals from three different transmitting stations, viz Delhi, Calcutta and Karachi, on 31-metre band were recorded at the same time. For the sake of convenience the various stations with lines of shortest distances between the transmitting stations and the receiving centre at Banaras are shown in Fig. 1 The dots on these lines indicate the approximate positions of the projections of the points of reflections in the ionosphere for singly and doubly reflected rays They are represented by D_1, D_2, D_3, etc , in which the letters indicate the names of transmitting stations and suffixes 1, 2 and 3 represent the points of single reflection, the first and second points of double reflection respectively The two circles around the receiving station at Banaras are drawn to show the equidistant points of reflection from the receiving centre

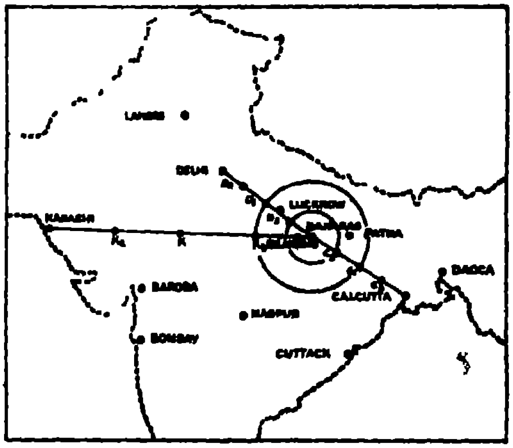

FIG 1 — THE LINES OF SHORTEST DISTANCES BETWEEN THE TRANSMITTING STATIONS AND THE RECEIVING STATION AT BANARAS

Figs 2 and 3 represent the fading patterns obtained for the receptions from Calcutta and Karachi respectively It will be observed that these patterns indicate slow random variations of intensity superimposed with ripples caused by double reflection associated with the vertical movement of the layer, as observed by Banerjee and his collaborators[2, 3] The possibility of double reflection is corroborated by the reception of signals from Delhi on 25 and 19-metre bands

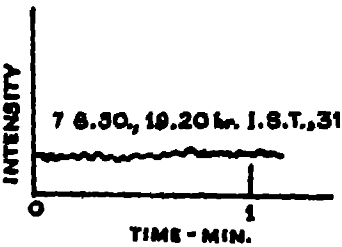

FIG 2 — FADING PATTERN FOR THE RECEPTIONS FROM CALCUTTA.

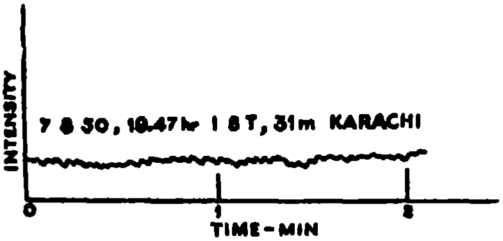

FIG 3 — FADING PATTERN FOR THE RECEPTIONS FROM KARACHI

as the average electron densities required for double reflection from Delhi on 31 metre band and for single reflection on 19 metre band are $0\,82\times10^{6}$ electrons/c c and $1\,50\times10^{6}$ electrons/c c respectively The types of fading as shown in Figs 2 and 3 are the normal patterns obtained on such occasions when the intensity of singly reflected signal is much greater than the doubly reflected one Fig 4 shows the effect of anomalous variations of such reflected waves on the fading patterns obtained for transmissions from Delhi It would be seen that the amplitudes of the ripples have very much increased due to the increase of intensity of doubly reflected wave compared to the intensity of singly reflected one It should be mentioned however that prior to the appearance of the undulations the fading pattern for the above transmission from Delhi on 31 metre band was of the normal type as represented in Figs 2 and 3 The absence of undulations in the fading patterns for Calcutta and Karachi shown in Figs 2 and 3 and their presence in the reception of signals from Delhi suggest the possibility of locating the positions of the undulations in the ionosphere From preliminary considerations it can be shown that they are not present in the west and south east directions from Banaras From the amplitudes of the ripples and average intensity of the received signal from Delhi shown in Fig 4 it can be inferred that the anomalous variations in the fading pattern are due to doubly reflected signals from Delhi Thus the undulations may be at the points in the ionosphere over D$_3$ or D$_2$ shown in Fig 1 The vertical incidence pulse transmissions over Banaras at the time of the above observations and on the same frequency band showed the absence of undulations This indicates that the undulations may be situated over D$_2$ and not over D$_3$ (FIG 1) and thus it may be possible to locate the position of the undulations in the ionosphere Further work in this direction is in progress and the results of detailed investigations will be published shortly in this journal

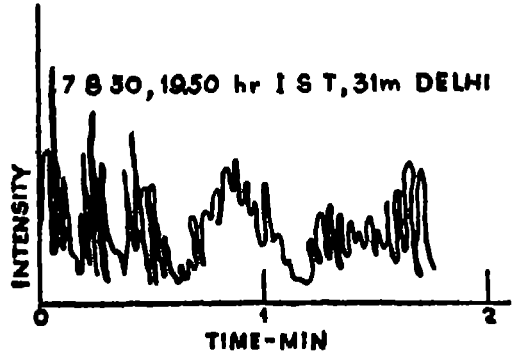

FIG 4 — EFFECT OF ANOMALOUS VARIATIONS OF REFLECTED WAVES ON FADING

The authors are thankful to the Council of Scientific & Industrial Research for the sanction of a grant for carrying out the above investigations Their thanks are also due to the Research Department of All India Radio for their continued co-operation during the progress of the work

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August 21 1950

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STUDIES IN THE SYNTHESIS OF QUINOLYL-TRICHLORO-ETHANES

IN VIEW OF THE ANTI TUBERCULAR ACTIVITY of 1 1 1 trichloro 2 2 bis (*p* aminophenyl) ethane[1] and also in consideration of the bactericidal properties of 8-oxyquinoline it was thought of interest to synthesize and study the physiological activity of quinolyl-trichloro-ethanes in which the lipid solubilizing trichloro-ethyl group is attached to 8-oxyquinoline

As a result of the present investigations, 1, 1, 1,-trichloro-2, 2,-bis-(8-oxy-x-quinolyl)-ethane, $C_{20}H_{13}O_2N_2Cl_3$, colourless prismatic rods, m p 240°C (decomp) has been synthesized by condensing chloral hydrate with 8-oxyquinoline in the presence of concentrated sulphuric acid The intermediate mono-condensation product, 1, 1, 1,-trichloro-2-hydroxy-2-(8-oxy-x-quinolyl)-ethane, $C_{11}H_8O_2NCl_3$, colourless plates, m p 130°C , as well as 8-oxyquinoline-5-sulphonic acid, light-yellow needles, m p 320°C , have also been obtained from the reaction mixture Further work in this line is in progress

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ALKALOIDAL CONSTITUENTS OF THE BARK OF *BERBERIS ARISTATA* (RASSAUT)

AS A RESULT OF FRACTIONATION OF THE initial crystallizate obtained from the alcoholic extract of the bark of *B. aristata*, Chakravarti, Dhar and Siddiqui[1] reported the isolation of three alkaloidal chlorides melting at 220°C (decomp), 204°C (decomp) and 165°C (decomp.) respectively The chloride, m p 220°C (decomp), was shown to be identical with berberine chloride , from the mother liquors of the initial crystallizate, berberine and palmatine were isolated through their respective chloride and iodide

A further study of the naturally occurring salt, m p 204°C (decomp), mentioned above, through the preparation, analyses and comparison of melting points and mixed melting points of its various salts, has established its identity with palmatine chloride On catalytic reduction the chloride yields tetrahydro-anhydro-palmatine (m p 147°C), identical with that obtained from an authentic sample

The chloride melting at 165°C (decomp) on reduction gave a mixture of tetrahydro-anhydro-berberine and tetrahydro-anhydro-palmatine and is a mixture of palmatine and berberine chlorides

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